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Solo® LX
CPAP System

Solo® Plus LX
CPAP System

# Service Manual

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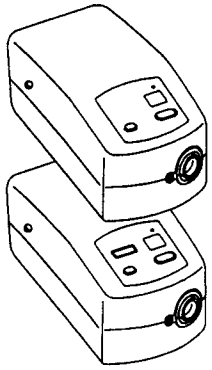

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**Solo LX and Solo Plus LX CPAP Systems Service Manual**

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Respironics warrants that the Solo LX and Solo Plus LX CPAP Systems shall be free from defects of workmanship and materials and will perform in accordance with the product specifications for a period of one year from the date of sale by Respironics. If the product fails to perform in accordance with the product specifications, Respironics will repair or replace—at its option—the defective material or part. Respironics will pay customary freight charges from Respironics to the dealer location only. This warranty does not cover damage caused by accident, misuse, abuse, alteration, and other defects not related to materials or workmanship.

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# Overview: Solo LX and Solo Plus LX CPAP Systems Service Manual

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|---|---|---|
| **Warranty** | | Details the Respironics warranty. |
| **Table of Contents** | | Lists the chapters included in this manual. |
| **Chapter 1:** | **Introduction** | Introduces the Solo LX and Solo Plus LX CPAP Systems. |
| **Chapter 2:** | **Warnings, Cautions, and Notes** | Lists the Warnings, Cautions, and Notes. |
| **Chapter 3:** | **Specifications, Features, Description, and Theory of Operation** | Describes the theory of operation for the units, including basic operations of the subsystems. |
| **Chapter 4:** | **System Setup Procedures** | Details system setup, including instructions on required, alternate, and optional patient accessories. |
| **Chapter 5:** | **Routine Maintenance** | Provides cleaning and routine maintenance instructions. |
| **Chapter 6:** | **Troubleshooting and Diagnostics** | Provides a troubleshooting flow chart and a troubleshooting table. |
| **Chapter 7:** | **Repair & Replacement** | Describes detailed procedures of removing and installing all major components within the units, including graphics and illustrations for visual identification. |
| **Chapter 8:** | **Testing** | Includes the System Final Test, Run-in Test, Post Testing Pressure Setup, and Data Sheet. |
| **Appendix A:** | **Tools and Equipment** | Details the necessary tools and test equipment required for servicing. |

| | |
|---|---|
| **Appendix B: Schematics** | Provides Printed Circuit Assembly (PCA) schematics. |

**NOTE:** These are proprietary and are to be used for reference only.

| | |
|---|---|
| **Index** | Item location guide. |

# Chapter 1: Introduction

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# Chapter 1: Introduction

## 1.1 Solo LX and Solo Plus LX CPAP Systems Overview

The Solo LX and Solo Plus LX CPAP Systems (Solo LX and Solo Plus LX), shown in Figure 1-1, are microprocessor-controlled devices that deliver Continuous Positive Airway Pressure (CPAP) therapy in one mode for the treatment of adult Obstructive Sleep Apnea (OSA) only. The CPAP mode provides a constant level of positive pressure throughout the breathing cycle to pneumatically splint the airway open.

The units incorporate a key pad with two User buttons, a Light-Emitting Diode (LED) signal light, a time meter (Solo Plus LX only), and a 2-digit LED display. The units may be operated using either AC (115 – 230 VAC) or DC (12 VDC) power.

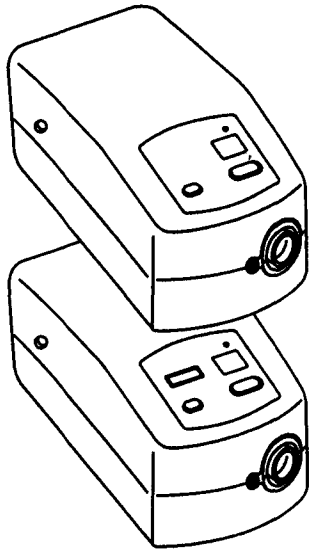

***Figure 1-1***
***Solo LX and Solo Plus LX CPAP Systems***

## 1.2 Service Notice

This service manual was prepared by Respironics primarily for use by technicians to service the Solo LX and Solo Plus LX Systems. The individuals using this manual to service the Solo LX and Solo Plus LX Systems should have prior training or experience servicing ventilatory devices.

## 1.3 Technical Support Statement

Respironics is committed to customer satisfaction and may be contacted with any questions or for technical support.
For technical assistance or replacement part ordering information contact your nearest Respironics Customer Satisfaction Center (CSC).

**U.S. and Canada**

**Phone:** **1-800-669-9234**
**Fax:** **Available from your nearest CSC**

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# Chapter 2: Warnings, Cautions, and Notes

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# Chapter 2: Warnings, Cautions, and Notes

**WARNING:** Indicates the possibility of injury to the patient, operator, or technician.

**CAUTION:** Indicates the possibility of damage to the devices.

**NOTE:** Places emphasis on an operating characteristic.

## 2.1 WARNINGS

### 2.1.1 Safety

- These devices are intended for adult use only.
- These devices are not intended for life support or life sustaining applications.
- The instructions in this manual are not intended to supersede established medical protocols.

### 2.1.2 Operational

- This warning applies to most Continuous Positive Airway Pressure (CPAP) devices. At low CPAP pressures, the air flow through the exhalation port may not be enough to clear all of the exhaled gas ($CO_2$) from the mask. You may breathe in some of the air that you have exhaled.
- Under certain conditions, the temperature of the air flow from these devices can be as much as 18°F (10°C) higher than the air temperature in the room. Caution should be exercised if the room temperature is warmer than 90°F (32°C).
- If oxygen is used with these devices, the oxygen flow must be turned off when the devices are turned off. If the air flow is turned off and the oxygen flow is left on, oxygen may accumulate in the Solo LX and Solo Plus LX CPAP Systems (Solo LX and Solo Plus LX) enclosure and may create a risk of fire. This warning applies to most types of CPAP devices.
- When supplemental oxygen is used at a fixed flow rate, inhaled oxygen concentrations will vary depending on pressure settings, patient breathing patterns, mask selection, and leak rate.
- Oxygen supports combustion. Do not use oxygen in the presence of open flames, cigarette smoke, electrical spark, or other sources of ignition.

*Warnings (Continued)*

- These devices are not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide.
- In situations where risk of contamination between the user and the device is high (e.g.: sleep lab devices; rental devices; users with respiratory infections), a low-resistance, main flow bacteria filter should be placed in-line between these devices and the circuit.
- Most CPAP devices have the potential to induce rebreathing of exhaled air. To reduce this potential, use only Respironics circuit accessories, do not wear the mask and headgear for more than a few minutes while the units are not operating, and do not block or try to seal the vent holes in the exhalation port.

## 2.1.3 Service

- Electronic components used in these devices are subject to damage from static electricity. Repairs made to these devices must be performed only in an antistatic, Electro-Static Discharge (ESD) - protected environment.
- To assure the safety of the service technician and the specified performance of the devices, Respironics recommends that only technicians having prior training or experience servicing ventilatory devices perform any repairs or adjustments to the Solo LX and Solo Plus LX.
- High voltages are present inside these devices. To avoid electrical shock, disconnect the electrical supply before attempting any repairs on the devices.

## 2.1.4 Cleaning

- To avoid electrical shock, disconnect the electrical supply before cleaning the units. DO NOT immerse these devices into any fluids.

## 2.2 CAUTIONS

- Federal law (U.S.) restricts these devices to sale by, or on the order of, a physician.
- Care should be taken to avoid exposure of the Solo LX and Solo Plus LX to temperatures at or near the extremes of those specified in Chapter 3. If exposure to such temperatures has occurred, the devices should be allowed to return to room temperature before being turned on.
- Always use both a pollen filter (RI P/N 622018) and an ultra-fine filter (RI P/N 622017) when the Solo LX and Solo Plus LX are in use.
- Never place liquids on or near the Solo LX and Solo Plus LX.
- Discontinue using these devices if any of the parts are damaged. Replace any damaged parts before continuing use.
- The information in this manual is provided for service personnel reference and is not intended for system setup or use. System setup should be performed by appropriate personnel using Home Care Dealer Instructions.

## 2.3 NOTES

- Refer to the Solo LX and Solo Plus LX User's Manual for product use additional warnings, cautions, and notes.

Additional WARNINGS, CAUTIONS, and NOTES are located throughout this manual.

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# Chapter 3: Specifications, Features, Description, and Theory of Operation

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# Chapter 3: Specifications, Features, Description, and Theory of Operation

## 3.1 Overview

This chapter describes the Solo LX and Solo Plus LX CPAP Systems (Solo LX and Solo Plus LX) specifications and system features, and provides a functional description and theory of operation of the units.

## 3.2 Specifications

**ENVIRONMENTAL:**

| | |
|---|---|
| Operating Temperature | 41 – 104°F (5 – 40°C) |
| Storage Temperature | -4 – 140°F (-20 – 60°C) |
| Humidity | 15 – 95% non-condensing |
| Outlet Temperature Rise | Shall not exceed 122°F (50°C) when operating at a maximum ambient temperature of 104°F (40°C). |

**NOTE:** The outlet temperature rise can be as much as 18°F (10°C) higher than room temperature measured at the end of a 6 ft. (1.83 m) tube.

| | |
|---|---|
| Atmospheric Pressure | 76.7 – 102 kPascals (Storage: 50 – 102 kPascals) |
| Elevation | 0 – 5,000 ft. and greater with three selected ranges available. |
| Noise Level | No specification is given because various test instruments, test procedures, and unit operating conditions produce varying results. Verify the pressure setting via a manometer for elevation settings over 5,000 ft. |

**FUSES:**

| | |
|---|---|
| Fuses | 0.8 amp or 800 ma time delay (100 – 120 VAC); 0.315 or 315 ma time delay (230 – 240 VAC) |
| Physical Fuse Size | 5 mm × 20 mm |

**PHYSICAL:**

| | |
|---|---|
| Electrical Safety | IEC 601-1, general safety requirement for medical devices |
| Dimensions | 10.00" (L) × 5.50" (W) × 4.75" (H) (25 × 14 × 12 cm) |
| Weight | 3.5 lbs (1.6 kg) |

**ELECTRICAL:**

| | |
|---|---|
| AC Input Voltage | 100 – 120 VAC; 230 – 240 VAC; 50 – 60 Hz |
| DC Input Voltage | 11 – 17 VDC |
| AC Current Consumption | T 800 ma at 115 VAC<br>T 315 ma at 230 VAC |
| DC Current Consumption | 3.0 A maximum, time delay, type MDL |
| Power Consumption | 80 VA maximum |

*Specifications (Continued)*

| | |
|---|---|
| Class | Class II |
| Type | Type BF |

**FUNCTIONS:**

| | |
|---|---|
| Modes | CPAP |

**EMC NORMATIVE DOCUMENTS:**

This product complies with the requirements found in the following documents:

| | |
|---|---|
| IEC 601-1-2 | Medical electrical equipment, general requirements for safety, and electromagnetic compatibility. |
| IEC 801-2 | Electrostatic discharge requirements for industrial process measurement and control equipment. |
| IEC 801-3 | Radiated electromagnetic field requirements for industrial process measurement and control equipment. |
| IEC 801-4 | Electrically fast transients for industrial process measurement and control equipment. |
| CISPR 11 | Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific, and medical (ISM) equipment. |

**ALTITUDE COMPENSATION:**

| | |
|---|---|
| Pressure Range | 4.0 – 15.0 cm $H_2O$ |
| Settings | Low<br>(0 – 2500 ft.; 0 – 762 m)<br><br>Mid (Medium)<br>(2501 – 5000 ft.; 763 – 1524 m)<br><br>High<br>(greater than 5,000 ft.) |

**TIME METER (SOLO PLUS LX ONLY):**

| | |
|---|---|
| Time Meter (LCD) | Total Operation Time |

*Specifications (Continued)*

**PRESSURE:**

| | |
|---|---|
| AC Operation | 4.0 – 15.0 cm $H_2O$ |
| DC Operation | 4.0 – 15.0 cm $H_2O$ |
| CPAP Mode | 4.0 – 15.0 cm $H_2O$ |
| Resolution | 0.5 cm |
| Accuracy | ±1.3 cm $H_2O$ or 15% of the indicated control setting (whichever is greater) This tolerance assumes system setup similar to maximum pressure test. |
| Setting Stability | ±1.0 cm $H_2O$ over 8 hours |

## 3.3 System Features

| | |
|---|---|
| AC Power Connector | Connect the AC power cord here. |
| Air Outlet Port | Connect the flexible tubing here. |
| Blower On / Off Button | This button turns the blower either on or off. |
| DC Power Connector | Optional DC power connection. |
| Filter Cap & Filters | The pollen filter screens out normal household dust and pollens. This must be in place at all times when the units are operating. An optional, ultra-fine filter is also included for more complete filtration of very fine particles. The filter cap can be positioned to direct the air flow away from your bedside. |
| Key Pad | Includes User buttons, LED signal light, time meter (Solo Plus LX only), and 2-digit LED display. |
| LED Signal Light | The green light signals when the units are ready for use. The light will go out when the air flow is turned on. A flashing light signals that the units need to be serviced. |

*System Features (Continued)*

| | |
|---|---|
| Power Cord | IEC 320 Style. |
| Ramp Button | This button initiates a ramp cycle which incrementally and automatically increases the pressure. |
| Time Meter | Records hours of operation. |
| 2-digit LED Display | Displays pressure and altitude setting. |
| User Buttons | These buttons (Blower On / Off and Ramp) can be used in combination to enter the Dealer mode functions. |

## 3.4 Functional Description

The Solo LX and Solo Plus LX are microprocessor-controlled Continuous Positive Airway Pressure (CPAP) devices that produce positive pressure.

The units operate in the CPAP mode. This mode delivers continuous positive airway pressure, maintaining a constant level of pressure throughout the breathing cycle. CPAP mode pressure range in AC and DC operation: 4.0 – 15.0 cm $H_2O$.

Integral to the generation of air flow is the blower assembly. Ambient air is drawn through the air intake filter, and pressurized by the energized blower. Ultimately, therapeutic pressure is provided to the patient via the patient circuit. The microprocessor regulates the motor speed, which in turn adjusts and controls the pressure.

The key pad, which includes two User buttons, a Light-Emitting Diode (LED) signal light, a time meter (Solo Plus only), and a 2-digit LED display, is the primary means by which the patient therapy is controlled. Patients have limited access to unit parameters.

The unit may be powered from either AC (100 – 120 VAC; 230 – 240 VAC) or from DC power (12 VDC). AC power enters the unit via an IEC-320 style AC inlet and appropriate power cord. A DC power connector enables the patient to use the system when AC voltage is not accessible.

*Functional Description (Continued)*

The two system filters, the pollen and the ultra-fine, ensure optimum operation for the user. An air outlet port allows for connection to the patient circuit.

The patient circuit is made up of the flexible tubing, outlet swivel with pressure tubing, exhalation port, and nasal mask. The units apply CPAP to the patient's upper airway to keep the airway open during sleep. Air flow generated from the units is directed to the patient via a mask and flexible tubing that connects to the air outlet port of the units.

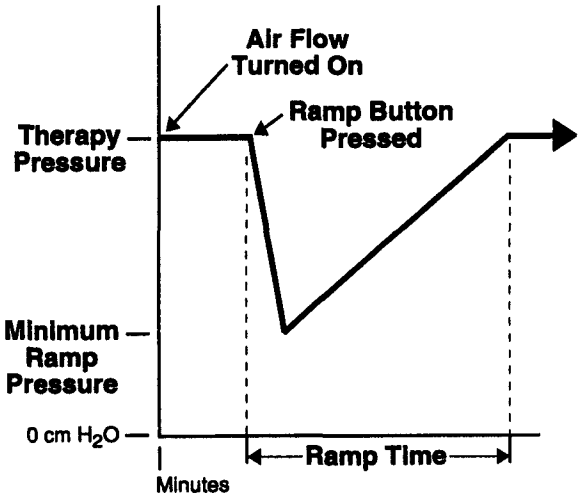



***Figure 3-1***
***Ramp Operation***

The Ramp feature lets the user reduce the pressure from the Solo LX and Solo Plus LX so that the patient can fall asleep at a lower, more comfortable pressure at any time or as many times as needed during the night.

**WARNING:** The units are intended to deliver CPAP therapy only. They are not intended for life support or life sustaining applications.

The following sections describe the major components of the Solo LX and the Solo Plus LX and their basic theory of operation.

## 3.5 Theory of Operation

### 3.5.1 Key Pad & Time Meter

The key pad consists of two User buttons (Ramp button, Blower On / Off button), a LED signal light, a time meter (Solo Plus LX only), and a 2-digit LED display. The Blower On / Off button activates and deactivates the pressure. The range of pressure is 4.0 to 15.0 cm $H_2O$ with AC and DC operation. The Ramp button initiates a ramp cycle which incrementally and automatically increases the pressure. The ramp begins at the minimum ramp pressure setting, and over the specified time period, increases until the therapeutic pressure is reached. Ramp time is factory set to 20 minutes. The LED signal light indicates power and blower On / Off status. The time meter indicates the total number of hours the unit has been in use. Three altitude compensation levels (low, medium, and high) may also be set. The 2-digit LED display indicates the altitude and pressure setting.

### 3.5.2 Main Printed Circuit Assembly (Main PCA)

The Main PCA is the control center of the units. The Main PCA utilizes two microcontroller chips which read from and write to various I/O devices (key pad, LED, motor control circuitry, etc.). With all of this information, the main microcontroller makes appropriate decisions so that the blower motor is properly controlled to deliver the desired CPAP therapy in a safe and reliable manner.

The main microcontroller and other interface circuitry provide closed loop control of the blower motor's speed. The blower motor is a three-phase brushless DC motor with a permanent magnet rotor and stationary coils that are connected in the "Y" configuration and serve as its stator coils. The stator coils are electrically switched or commutated by drive circuits with the power FET transistors. Proper timing and sequencing of the stator coil switching is provided by the motor microcontroller which senses the motor's shaft position by monitoring the back-EMF voltage in one of the motor's stator coils.

The main microcontroller also sets the motor speed (and consequently the output pressure) by varying the voltage which is delivered to the motor. It does this by controlling the pulse duty cycle of a switching power supply (boost mode) on the Main PCA.

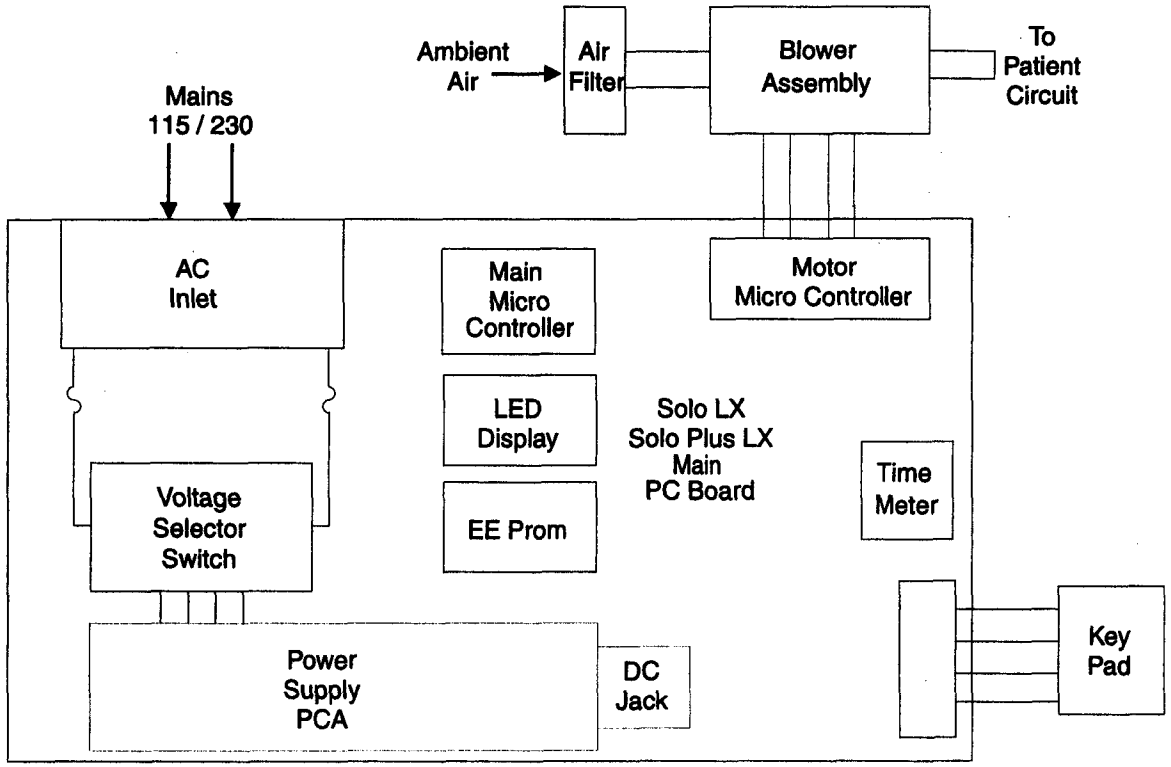
The time meter PCA does not require electrical power from an on-board battery to retain time. The battery ensures that a time keeping function is always active.

### 3.5.3 Power Supply Printed Circuit Assembly (Power Supply PCA)

The Solo LX and Solo Plus LX is operational over the input voltage ranges of 100 – 120 VAC @ 50 – 60 Hz, 230 – 240 VAC @ 50 – 60 Hz, or 11 – 17 VDC. A patient accessible voltage selector switch is provided for 115 and 230 volt selection.

A DC jack is provided for 11 – 17 VDC operation.

## 3.6 Block Diagram



# Chapter 4: System Setup Procedures

4.1 Overview ..... 4-3

4.2 System Setup ..... 4-3

4.3 Required, Alternate, and Optional Circuit Accessories ..... 4-6

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# Chapter 4: System Setup Procedures

## 4.1 Overview

This section provides an overview of the system setup including detailed required, alternate, and optional circuit accessories. See Chapter 5 – Routine Maintenance, for filter and filter cap installation instructions

**CAUTION:** If the Solo LX and Solo Plus LX CPAP Systems (Solo LX and Solo Plus LX) have been exposed to either very hot or very cold temperatures, allow them to adjust to room temperature (approximately two hours) before beginning setup.

## 4.2 System Setup

**Step 1** If installed, remove the protective cap from the air outlet. Install the test orifice (RI P/N 622032) onto the unit outlet.

**Step 2** Plug the male end of the AC power cord into an electrical outlet.

**Step 3** Simultaneously, press the two User buttons and plug the female end of the AC power cord into the AC inlet on the back of the unit. Hold the two User buttons down.

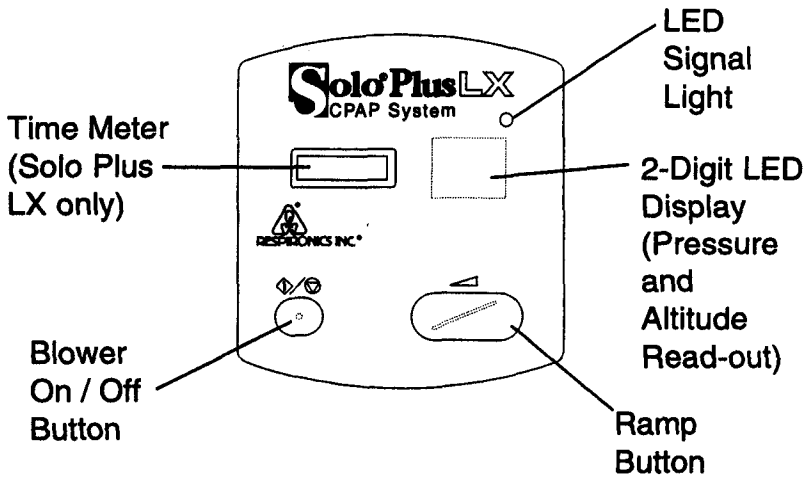


*Figure 4-1*
*Key Pad Features*

*System Setup (Continued)*

**NOTE:** DO NOT turn the airflow on until a test adapter is connected. (RI P/N 622032)

## 4.2.1 Self-Diagnostic Test

After the unit is plugged into an electrical outlet, it will perform a Self-Diagnostic Test. To turn the blower on, press the Blower On / Off button once.

The Light-Emitting Diode (LED) signal light will illuminate when the unit is ready for use. The LED goes out when the airflow is turned on. A flashing LED signals a system error. For further instructions, refer to the Routine Use section in the User's Manual.

## 4.2.2 Setting the Altitude

The altitude may be set in the Dealer mode. While holding down the two User buttons on the key pad, plug the AC power cord into the unit. The altitude setting will be displayed on the 2-digit LED. To ensure proper therapy, this setting needs to be accurate for the patient's current location.

LOW 0 – 2,500 ft. (0 – 762 m)

MID 2,501 – 5,000 ft. (763 – 1,524 m)

HIGH greater than 5,000 ft.

If the correct setting is displayed, press the left User button. To change the altitude setting, press the right User button until the correct setting is displayed.

**NOTE:** Altitudes over 5,000 ft. (1,524 m) may affect the accuracy of the pressure. Verify the pressure settings with a manometer.

*System Setup (Continued)*

## 4.2.3 Setting the Pressure

a. Connect the following:

- 6 ft. Smooth-Bor tubing to the outlet port on the unit.
- Whisper Swivel II to the 6 ft. Smooth-Bor tubing.
- Test orifice 60 lpm @ 14.4 cm (RI P / N 622032) to the Whisper Swivel II.
- Manometer and pressure tubing to test orifice.
- Occlude test orifice.

b. Ensure the blower is off. Unplug the AC power cord from the unit. The green LED will go out.

c. While holding down the two User buttons on the key pad, plug the AC power cord into the unit. The same displays used for the Minimum Pressure Test (see Section 8.2) should be visible.

d. Verify the following:

- the blower is running in the unit; and
- the proper altitude setting is indicated on the display.

e. Press the left User button once until the Pressure display appears.

f. Press the right User button until "15" appears.

g. Press the Blower On / Off button and verify the pressure on the manometer is 15.0 cm $H_2O$ (±2.25 cm $H_2O$).

# 4.3 Required, Alternate, and Optional Circuit Accessories

This section addresses the required, alternate, and optional circuit accessories that can be used with the Solo LX and Solo Plus LX. For additional information, refer to the User's Manual or the Home Care Providers Manual or the literature supplied with the accessory.

## 4.3.1 Required Accessories

To use the Solo LX and Solo Plus LX Systems, the following accessories are required in order to assemble the circuit.

**WARNING:** The Solo LX and Solo Plus LX Systems should only be used with the recommended patient circuit identified below.

Recommended Patient Circuit

- Respironics Nasal Mask & Whisper Swivel® II Exhalation Port (or Respironics mask w/integrated exhalation port such as the Monarch® Mini Mask)
- Respironics 6 ft. (1.83 m) Flexible Tubing Assembly (reusable or lightweight)
- Respironics Headgear or Softcap™ (not shown)

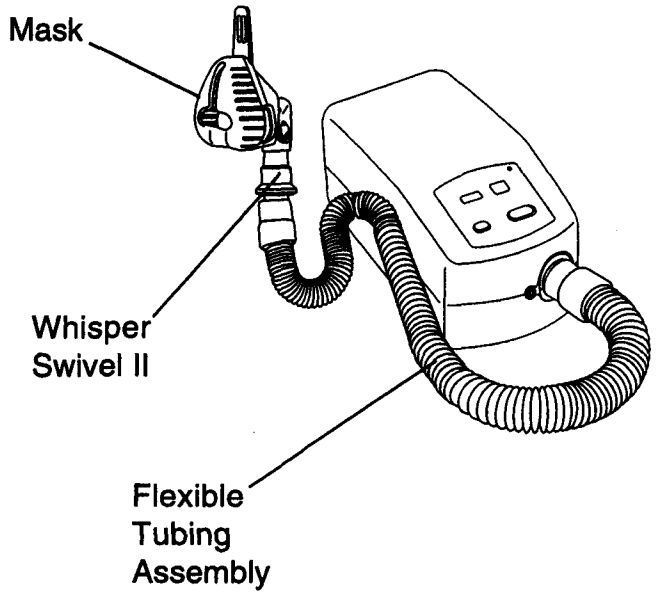


***Figure 4-2***
***Unit with Circuit***

## 4.3.2 Alternate and Optional Circuit Accessories

The Respironics alternate accessories, listed in Table 4-1, can be used in place of the recommended accessories. The optional accessories can be added to the patient circuit. Refer to Table 4-1 for changes in the pressure / flow characteristics when using these accessories.

**Table 4-1, Patient Circuit Accessory Pressure / Flow Characteristics**

| | Pressure Drop @ 30 lpm (cm $H_2O$) | Pressure Drop @ 60 lpm (cm $H_2O$) |
|---|---|---|
| **Recommended Patient Circuit** | | |
| Nasal Mask (disposable, reusable) | 0.03 | 0.09 |
| GoldSeal™ Nasal Mask (reusable) | 0.03 | 0.09 |
| Monarch® Mini Mask | 0.20 | 0.77 |
| Whisper Swivel® II (reusable) | 0.02 | 0.08 |
| 6 ft. (1.83 m) Reusable Flexible Tubing | 0.11 | 0.30 |
| **Alternate Accessories** | | |
| Spectrum® Disposable Full Face Mask | 0.04 | 0.10 |
| Plateau™ Exhalation Valve (reusable) | 0.05 | 0.20 |
| 6 ft. (1.83 m) Disposable Circuit & Exhalation Port | 0.20 | 0.34 |
| **Optional Accessories** | | |
| Respironics Oasis™ Humidifier | 0.14 | 0.40 |
| 24 in. Reusable Tubing (used with humidifier) | 0.03 | 0.10 |
| 18 in. Disposable Tubing (used with humidifier) | 0.00 | 0.00 |
| 18 in. Reusable Tubing (used with humidifier) | 0.00 | 0.10 |
| King Bacteria Filter (disposable) | 0.74 | 1.65 |
| Comfort Flap® Mask Accessory (reusable) | 0.00 | 0.00 |

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# Chapter 5: Routine Maintenance

5.1 Overview ..... 5-3

5.2 Cleaning the System ..... 5-3

5.2 Recording the Total Operating Time (Solo Plus LX Only) ..... 5-3

5.4 Cleaning / Replacing the Intake Filters ..... 5-4

5.5 Solo LX and Solo Plus LX CPAP Systems Preventive Maintenance Schedule ..... 5-5

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# Chapter 5: Routine Maintenance

## 5.1 Overview

This chapter provides guidelines and illustrates the cleaning and maintenance procedures for the Solo LX and Solo Plus LX CPAP Systems (Solo LX and Solo Plus LX).

Before cleaning or performing any routine maintenance, always switch the Blower On / Off button to the Off position and unplug the power cord from the rear of the unit.

## 5.2 Cleaning the System

**WARNING:** To avoid electrical shock, disconnect the electrical supply before attempting to clean the units. DO NOT immerse the units in water or allow any liquid to enter the cabinet or the filter intake.

**Step 1** Wipe the outside of the unit with a cloth slightly dampened with water and a mild detergent. Let the unit dry before reconnecting the electrical supply.

## 5.3 Recording the Total Operating Time (Solo Plus LX Only)

The total operating time is displayed on the Solo Plus LX time meter. The time meter is located on the left display and is signified by an hourglass icon.

The total operating time is the total number of hours the unit has been in use. This total includes factory testing time.

## 5.4 Cleaning / Replacing the Intake Filters

The gray pollen filter is a reusable filter that screens out pollens and some household dust. This filter should be cleaned at least once every two weeks under normal usage, or as required, and replaced with a new one every six months. One additional pollen filter is included with the systems. The pollen filter must be in place at all times when the units are operating.

The disposable white ultra-fine filter increases filtration of pollens, dust, some tobacco smoke, and small particles. The ultra-fine filter is included with the systems, but is optional and should be used in addition to the pollen filter. The ultra-fine filter should never be used without the pollen filter. Replace the ultra-fine filter after 30 nights of use or sooner if it appears dirty. DO NOT clean the ultra-fine filter.

**CAUTION:** Failure to replace a dirty filter may cause the devices to operate at higher then normal temperatures and damage the devices.

### 5.4.1 Removing, Cleaning, and Replacing the Filters

**Step 1** With the air flow turned off, disconnect the AC or DC power cord from the back of the unit.

**Step 2** Remove the filter cap by gently pressing down on the top of the filter cap, then pulling it away from the back of the unit.

**Step 3** Remove the pollen filter by gently pulling the edges of the filter. Rinse the filter in a steady stream of running water. Squeeze out the water, and repeat. Allow the pollen filter to air dry on a rack for 8 to 12 hours, or in a clothes dryer for 15 to 20 minutes.

**Step 4** If you are using the white ultra-fine filter, remove the ultra-fine filter if it appears dirty and discard. Replace with a new filter. Make sure the filter is lying flat.

**Step 5** Place the pollen filter over the ultra-fine filter, if used. Install the filter(s) into the filter area in the back of the unit.

*Cleaning / Replacing the Intake Filters (Continued)*

**CAUTION:** The pollen filter must be completely dry before use. Never place a wet filter into the device. Respironics recommends that you clean the filter in the morning and alternate using the two pollen filters provided with the systems to ensure enough drying time for the cleaned filter.

**Step 6** Install the filter cap. The opening in the filter cap can be installed in either direction.

## 5.5 Solo LX and Solo Plus LX CPAP Systems Preventive Maintenance Schedule

The following Preventive Maintenance Schedule lists the items that must be inspected or tested periodically, or after service is performed. Use the Preventive Maintenance Schedule to record the dates on which the maintenance items are performed.

You may photocopy the Preventive Maintenance Schedule for each unit serviced.

## 5.5.1 Solo LX and Solo Plus LX Preventive Maintenance Schedule (Factory Recommended)

Model No. _____ Serial No. _____ Date _____ Service Technician _____

| Maintenance Item | Verification Reference | Service Interval | Date |
|---|---|---|---|
| Record hours of operation (Solo Plus LX only) | Time meter | As desired | |
| Replace pollen filter | Section 5.4.1 | Clean every 2 weeks, or as required;<br>Change every 6 months, or as required | |
| Replace ultra-fine filter (if used) | Section 5.4.1 | Replace after 30 nights of use (sooner if it appears dirty) | |
| Perform Testing Process | Section 8.1 | After service is performed | |
| Cleaning | Section 5.2 | As required | |

# Chapter 6: Trouble-shooting and Diagnostics

6.1 Overview ..... 6-3
6.2 Troubleshooting Flow Chart ..... 6-4
6.3 Troubleshooting Table ..... 6-5

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# Chapter 6: Troubleshooting and Diagnostics

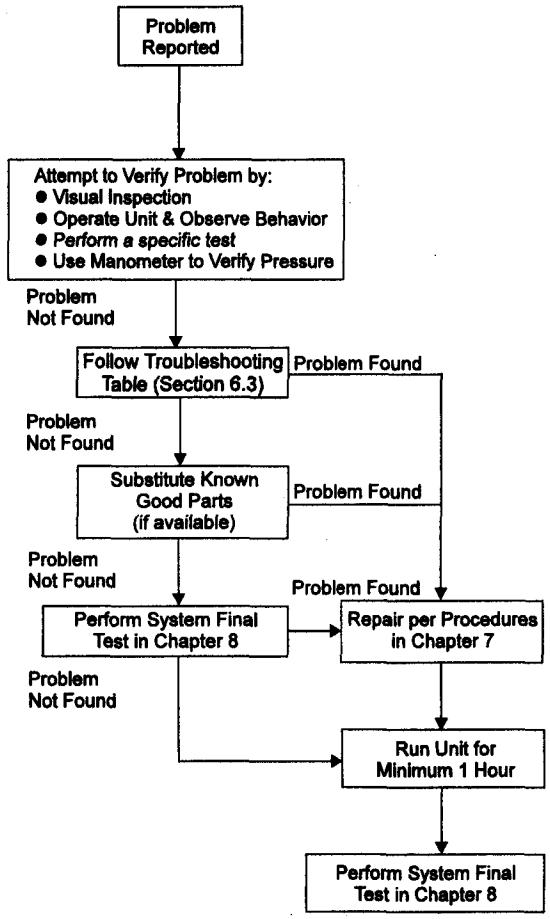
## 6.1 Overview

**WARNING:** Electrical Shock Hazard: Disconnect the electrical supply before repairing the units.

**CAUTION:** Electronic components used in these units are subject to damage by static electricity. Use proper static discharge equipment and grounding precautions when servicing the equipment. Service only at a static-free workstation.

This section contains information necessary to troubleshoot and diagnose problems with the Solo LX and Solo Plus LX CPAP Systems (Solo LX and Solo Plus LX). It provides a summary of common system problems as well as a flowchart and table to simplify the troubleshooting process.

## 6.2 Troubleshooting Flow Chart


Problem Reported
Attempt to Verify Problem by:
● Visual Inspection
● Operate Unit & Observe Behavior
● Perform a specific test
● Use Manometer to Verify Pressure
Problem Not Found
Follow Troubleshooting Table (Section 6.3)
Problem Found
Problem Not Found
Substitute Known Good Parts (if available)
Problem Found
Problem Not Found
Perform System Final Test in Chapter 8
Problem Found
Repair per Procedures in Chapter 7
Problem Not Found
Run Unit for Minimum 1 Hour
Perform System Final Test in Chapter 8

## 6.3 Troubleshooting Table

| Symptom | Cause | Verification | Corrective Action |
|---|---|---|---|
| **Indicator -**<br>LED or other indicator not working. | • Key pad<br>• Interface cable loose<br>• Main PCA | Check connection between the key pad ribbon cable and the Main PCA.<br>Check connection between Main PCA and Power Supply PCA. | Check for secure connection of ribbon cable connector.<br>• Replace Main PCA<br>• Replace Power Supply PCA |
| **Time Meter -**<br>Display is blank or contains erroneous information. | • Main PCA | Check connection between Main PCA and Power Supply PCA. | Replace in order until solved:<br>• Main PCA<br>• Power Supply PCA |

*Troubleshooting Table (Continued)*

| Symptom | Cause | Verification | Corrective Action |
|---|---|---|---|
| **Intermittent Power Supply Problem -**<br>An intermittent on / off condition exists, or indicator lights blink sporadically. | • Power cord, AC inlet, Main PCA, loose connections.<br>• Power Supply PCA. | Inspect power cord for fraying at cable ends. Inspect all connectors on the PCAs.<br>U2 Pin 14 =<br>+5.00 VDC ± 0.15 VDC | If power supply DC voltage is not within specifications, replace Power Supply PCA. If power cord or connectors are faulty, replace items as required.<br>If +5 supplies are not within specifications, replace Main PCA. |

*Troubleshooting Table (Continued)*

| Symptom | Cause | Verification | Corrective Action |
|---|---|---|---|
| **Unit Does Not Operate from the 12 VDC Power Source** - Units blow fuses in the DC cord during DC operation. | Faulty DC plug, low DC voltage, fuse in DC cord is blown.<br><br>Power Supply PCA | Ensure the DC supply is a minimum of 12 VDC. Ensure the DC voltage is stable. Monitor the voltage at the back of the DC connector mounted on the Main PCA. If DC voltage is below 11.5 VDC, replace or recharge DC source. If there is no DC measured at the Power Supply PCA, then check DC adapter cord for continuity. | • If DC cord or source is not at 12 VDC, replace or recharge as required.<br><br>• If 12 VDC supply is OK, replace Main PCA. |
| **Noise** - | Loose screws.<br><br>Missing or damaged bottom strip on bottom of unit, blower malfunctioning. | Inspect for any loose screws.<br><br>Turn unit over and inspect the bottom for missing or damaged bottom strip. | • Tighten any loose screws.<br><br>• If bottom strip is missing, replace bottom strip.<br><br>• Replace blower. |

*Troubleshooting Table (Continued)*

| Symptom | Cause | Verification | Corrective Action |
|---|---|---|---|
| **Odor -** | Tubing smells new, units smells new, airborne residue buildup. | Visually inspect patient tubing for contamination. | Run unit in a clean environment for a few hours to eliminate new smell. Wash tubing with soap and water. To clear residue build-up, replace all subassemblies in the patient air stream (blower, filters, patient circuit). |
| **Outlet Air Temperature -** The outlet air temperature is too warm. | Blower, Power Supply PCA.<br><br>Unit too close to external heat source. | Monitor the outlet air temperature at the end of the six foot tubing. A rise in temperature can be expected. Ensure the unit is not next to any heat source greater than 18°F above room temperature and is not in an enclosed environment. | Replace:<br>• Blower<br>• Power Supply PCA<br><br>Move unit away from external heat source. |

*Troubleshooting Table (Continued)*

| Symptom | Cause | Verification | Corrective Action |
|---|---|---|---|
| **Pressure Related Problems -** The outlet pressure does not change or properly adjust. | Main PCA or blower malfunction. | Check blower for air leaks. | • Replace pressure tubing, blower, or Main PCA as required. |
| **Pressure Offset -** Static pressure fluctuates -1.0 cm to +2.0 cm $H_2O$. | The delivered pressure is higher or lower than the set value by more than +2.0 / -1.0 cm $H_2O$. | Perform power up process.<br>Check altitude setting. | • Replace blower.<br>• Replace Main PCA.<br>Set the correct altitude |
| **Unit Blower Turns on When Power Cord is Plugged In.** | Unit was unplugged with blower running. | Plug unit in. If blower turns on without pressing the Blower On / Off button, reset the unit. | Turn the blower off and remove the AC power. |

*Troubleshooting Table (Continued)*

| Symptom | Cause | Verification | Corrective Action |
|---|---|---|---|
| **Ramp Pressure -**<br>The pressure does not ramp correctly. | • Main PCA.<br>• Ramp button not functioning. | Press the Ramp button and verify that the pressure drops below 5.0 cm $H_2O$. Pressure will increase in a linear fashion over time until the pressure setting is reached. Verify one increase in pressure change in ramp operation. | • Replace Main PCA<br>• Replace key pad |
| **Pressure Variation -**<br>The pressure varies around the set value, pressure fluctuates greater than 1.0 cm $H_2O$. | • Internal air leak<br>• Filters dirty<br>• Main PCA, blower<br>• Altitude setting<br>• Air path blocked | Check filters.<br>Perform Testing Process (see Chapter 8). | Verify proper altitude setting.<br>Clean / replace filters.<br>Replace blower.<br>Clear air path.<br>If pressure still drifts, then replace Main PCA. |

# Chapter 7: Repair & Replacement

7.1 Overview ..... 7-3

7.2 Solo LX and Solo Plus LX CPAP Systems Repair Kits ..... 7-5

7.3 Warnings and Cautions ..... 7-9

7.4 Replacement Instructions ..... 7-9

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# Chapter 7: Repair & Replacement

## 7.1 Overview

Figure 7-1 lists the names and identifies the locations of the replaceable components in the Solo LX and Solo Plus LX CPAP Systems (Solo LX and Solo Plus LX). The illustrations provide a quick reference and overview of the units. Within each replacement section, more detailed support information is provided to illustrate the exact component location and replacement procedure(s).

For technical assistance or replacement part ordering information contact your nearest Respironics Customer Satisfaction Center (CSC).

**U.S. and Canada**

**Phone:** **1-800-669-9234**
**Fax:** **Available from your nearest CSC**

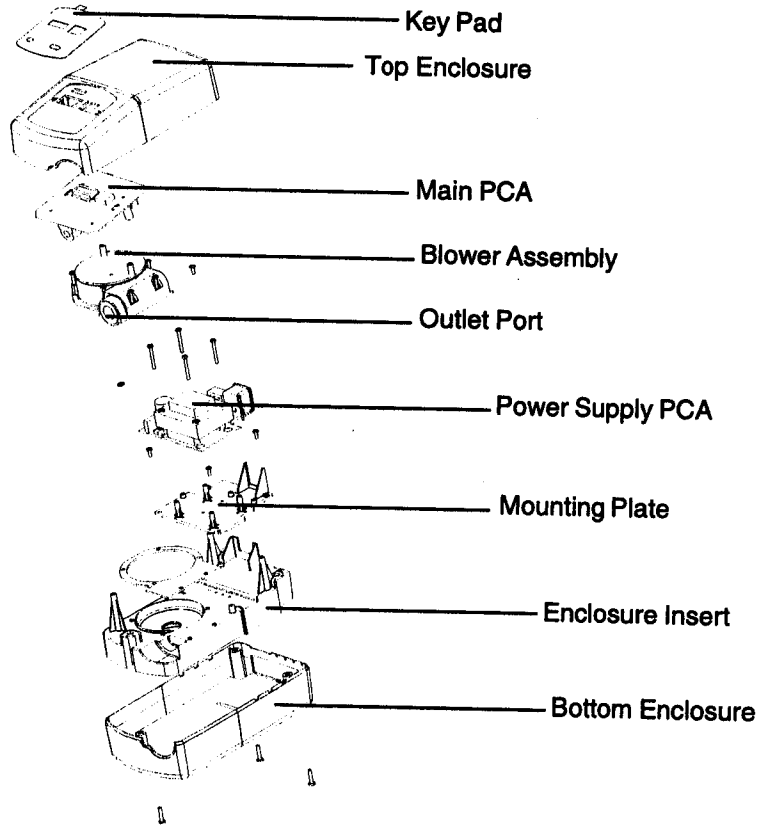
**International**

**Phone:** **1-412-731-2100**
**Fax:** **1-412-473-5012**

Visit Respironics Home Page on the World Wide Web at:

**www.respironics.com**

## 7.1.1 Solo LX and Solo Plus LX CPAP Systems Exploded View




Not Shown:
AC Power Cord
Bottom Strip
DC Power Cord
Filter Cap
Fuse Drawer
Fuses
Pollen Filter
Ultra-fine Filter

**NOTE:** The time meter is available with the Solo Plus LX only.

*Figure 7-1*
*Solo LX and Solo Plus LX CPAP Systems Exploded View*

## 7.2 Solo LX and Solo Plus LX CPAP Systems Repair Kits

| Replacement Part | Replacement Part No. | Page No. |
|---|---|---|
| AC Power Cord (U. S. and Canada) | 362524 | N.A. |
| AC Power Cord (International) | See Note [1] | N.A. |
| Blower Assembly<br>Includes: • Blower assembly (w / foam baffle)<br>• Blower-to-enclosure insert seal<br>• 6-13 x 1" screw (x6)<br>• Ferrite clamp-on (not used for this repair<br>• Pressure tubing (not used for this repair) | 622115 | 7-29 |
| Bottom Enclosure (Solo LX and Solo Plus LX)<br>Includes: • Bottom enclosure (w / foam baffle and label)<br>• Bottom strip<br>• 8-11 x 3/4" screw (x3) | 622116<br>See Note [2] | 7-14 |
| Bottom Strip | 622122 | 7-12 |

*Solo LX and Solo LX CPAP Systems Repair Kits (Continued)*

| Replacement Part | Replacement Part No. | Page No. |
|---|---|---|
| Power Supply Printed Circuit Assembly (Power Supply PCA)<br>Includes: • Power supply PCA<br>• 6-13 x 3/8" screw (x2) | 622265 | 7-32 |
| Solo LX and Solo Plus LX Service Manual | 622273 | N.A. |
| Test Orifice (used for testing) | 622032 | N.A. |
| Top Enclosure<br>Includes: • Top enclosure (w / foam baffle)<br>• 8-11 x 3/4" screw (x3)<br>• Tinnerman fastener (x2) | 622266 | 7-16 |

**Comments:**
- Illustration is shown on page 7-4.
- All items have a quantity of one unless otherwise specified.
- Part replacement procedures are detailed within this chapter.
- Assorted tubing, cables, and hardware are supplied with each Replacement Kit.

**Note 1:** Contact Respironics International Customer Service for further AC Power Cord information.

**Note 2:** Contact Respironics Technical Service Department or a Respironics Customer Satisfaction Center for bottom enclosure ordering information.

## 7.3 Warnings and Cautions

**WARNING:** To prevent electrical shock, disconnect the electrical supply before attempting to make any repairs to the units.

**CAUTION:** Electronic components used in these units are subject to damage from static electricity. Repairs made to the below listed sub-assemblies must be performed only in an antistatic, Electro-Static Discharge (ESD)-protected environment.

## 7.4 Replacement Instructions

See Figures 7-2 and 7-3 before removing or installing any component. These figures will detail the order in which each item must be removed or installed and should be used as a guideline for quick reference.

*Replacement Instructions (Continued)*

## Removal Flow Chart

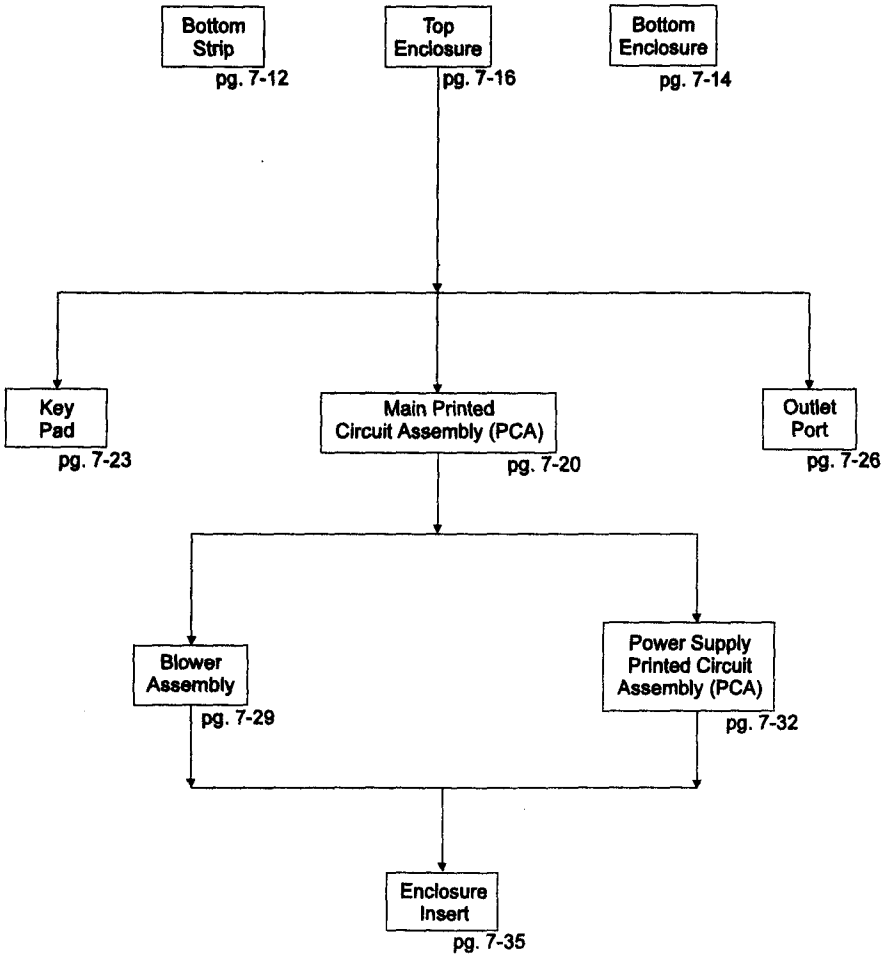



***Figure 7-2***
***Removal Flow Chart***

**Chart Usage:** Determine which item is to be replaced then follow the line of flow back to the "Top Enclosure" and begin the removal process. Detailed procedures begin on the referenced page numbers.

## Installation Flow Chart

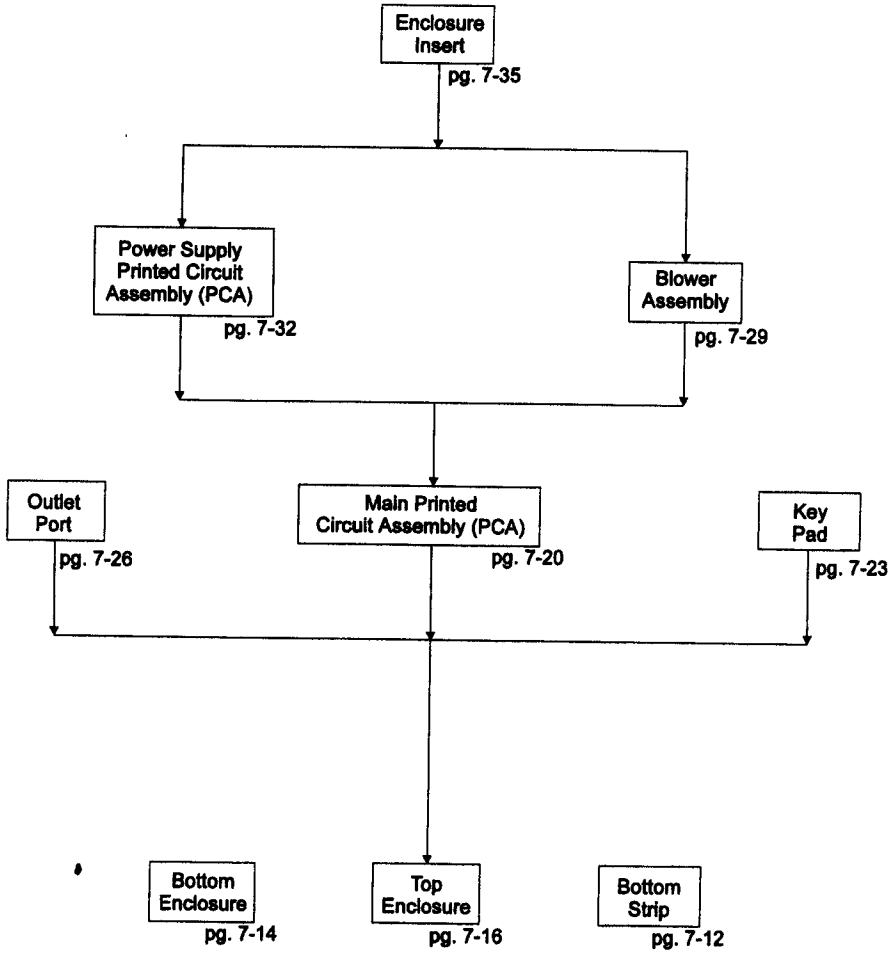



***Figure 7-3***
***Installation Flow Chart***

**Chart Usage:** Determine which item is to be installed then follow the line of flow down to the "Top Enclosure" and begin the installation process. Detailed procedures begin on the referenced page numbers.

## 7.4.1 Bottom Strip Replacement

### Replacement Part Number 622122

| Included in Kit: | Tools Required: |
|---|---|
| Bottom strip | Isopropyl alcohol<br>Cleaning cloth |

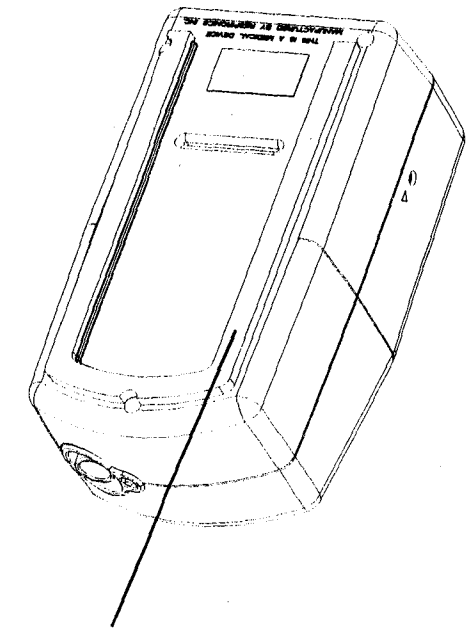
### Procedure

Removed / Installed During Process:

- Bottom strip

**WARNING:** Electrical shock hazard: Disconnect the electrical supply before attempting to make any repairs to the devices.

**CAUTION:** Electronic components used in these devices are subject to damage from static electricity. Repairs made to these devices must be performed only in an antistatic, ESD-protected environment.



*Bottom Strip Replacement (Continued)*

*Step 1 Removing the Bottom Strip*

a. Place the unit on a protected work surface and carefully turn it over, exposing the bottom.

b. Starting at one end, peel the bottom strip from the bottom enclosure.

c. Use a cleaning cloth with a small amount of isopropyl alcohol to remove any adhesive residue remaining on the bottom enclosure.

*Step 2 Installing the Bottom Strip*

a. Remove the protective backing from the bottom strip.

b. Align the bottom strip with the rib on the bottom enclosure.

c. Starting at one end, set the bottom strip in place.

d. Press the bottom strip firmly in place.

e. Carefully return the unit to the upright position.

## 7.4.2 Bottom Enclosure Replacement

### Replacement Part Number 622116

| Included in Kit: | Tools Required: |
|---|---|
| Bottom enclosure (w / foam baffle and label)<br>Bottom strip<br>8-11 x 3/4" screw (x3) | Phillips screwdriver (medium) |

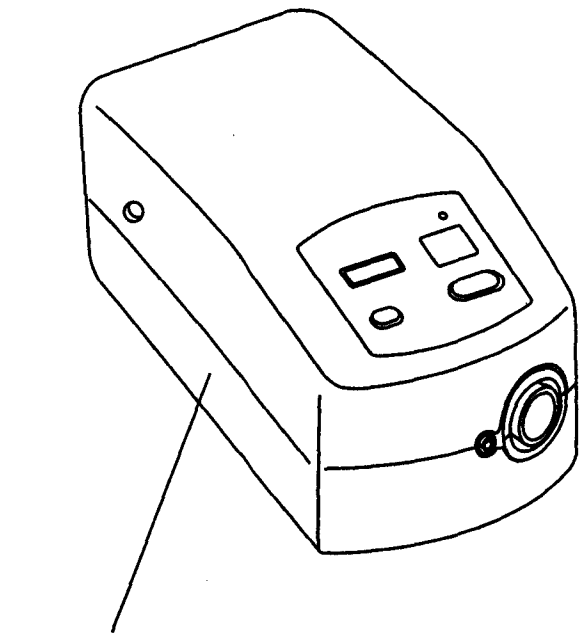
### Procedure

Removed / Installed During Process:

- Bottom enclosure

**WARNING:** Electrical shock hazard: Disconnect the electrical supply before attempting to make any repairs to the devices.

**CAUTION:** Electronic components used in these devices are subject to damage from static electricity. Repairs made to these devices must be performed only in an antistatic, ESD-protected environment.



*Bottom Enclosure Replacement (Continued)*

### *Step 1 Removing the Bottom Enclosure*

a. Place the unit upside down on a protected work surface.

b. Using a Phillips screwdriver, remove the three screws that secure the bottom enclosure to the top enclosure.

c. Lift the bottom enclosure from the rest of the unit.

d. Carefully, and away from the unit, turn the bottom enclosure over and remove the screws.

### *Step 2 Installing the Bottom Enclosure*

a. Align and place the bottom enclosure onto the enclosure insert.

**NOTE:** Ensure that the outlet port is properly seated in the bottom enclosure.

b. Install and secure the three screws.

c. Return unit to upright position.

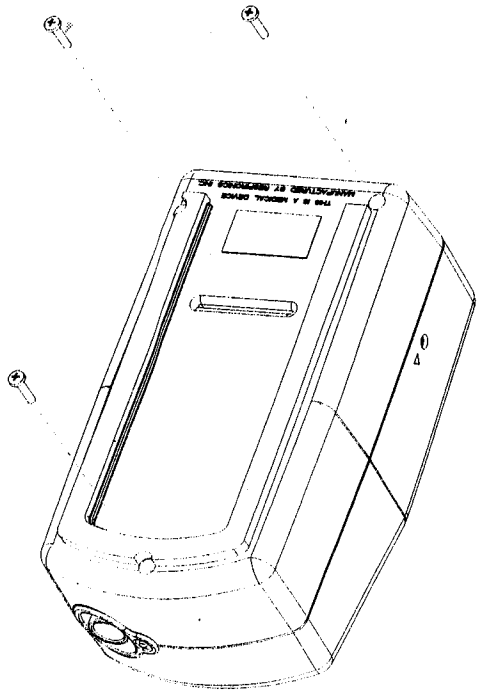


***Figure 7-4***
***Removing the Bottom Enclosure Screws***

## 7.4.3 Top Enclosure Replacement

### Replacement Part Number 622266

| Included in Kit: | Tools Required: |
|---|---|
| Top enclosure (w / foam baffle)<br>8-11 x 3/4" screw (x3)<br>Tinnerman fastener (x2) | Phillips screwdriver (medium) |

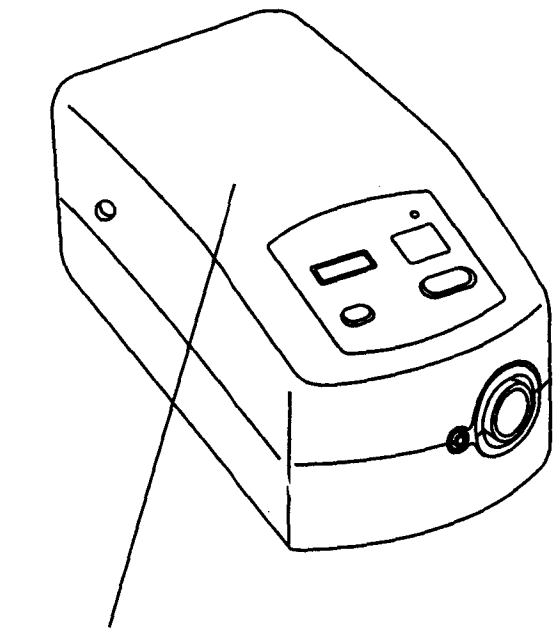
### Procedure

Removed / Installed During Process:

- Top enclosure
- Main PCA
- Key pad

**WARNING:** Electrical shock hazard: Disconnect the electrical supply before attempting to make any repairs to the devices.

**CAUTION:** Electronic components used in these devices are subject to damage from static electricity. Repairs made to these devices must be performed only in an antistatic, ESD-protected environment.



Top Enclosure

*Top Enclosure Replacement (Continued)*

*Step 1 Removing the Top Enclosure*

a. Place the unit on a protected work surface and carefully turn it over, exposing the bottom.

b. Using a Phillips screwdriver, remove the three screws that secure the top enclosure to the bottom enclosure.

c. While securely holding the top and the bottom enclosure together, carefully return the unit to its upright position.

d. Partially separate the top enclosure from the bottom enclosure.

**NOTE:** The top enclosure is still connected to the unit via the blower cable and the power supply PCA cable. These will be removed during the following steps.

e. Lift the top enclosure and hold it slightly above the unit to provide access to the blower cable and the power supply PCA cable.

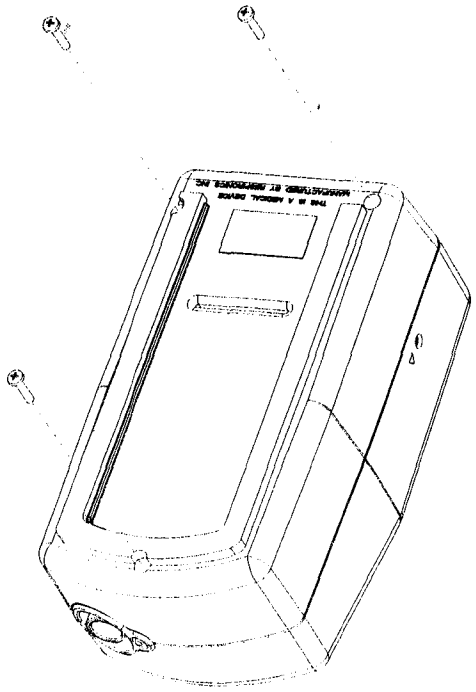


***Figure 7-5***
***Location of the Screws***

*Top Enclosure Replacement (Continued)*

f. Remove the blower cable and the power supply PCA cable connectors by gently pulling them straight out from their receptacles. The top enclosure is now free from the rest of the unit.

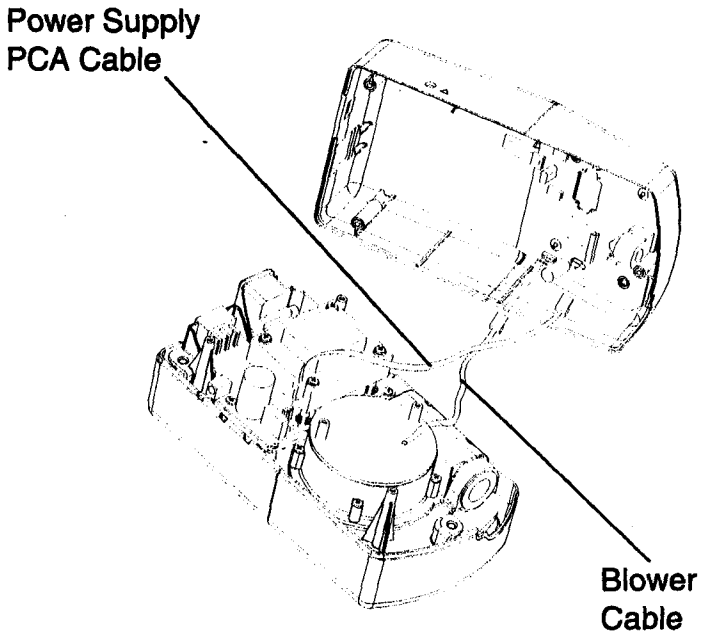



***Figure 7-6***
***Removing the Blower and Power Supply PCA Cables***

*Step 2* *Removing the Main PCA*

Remove:
- two Tinnerman fasteners
- main PCA

(See Section 7.4.4 for more detailed instructions on removing the Main PCA.)

*Step 3* *Removing the Key Pad*

Remove:
- key pad

(See Section 7.4.5 for more detailed instructions on removing the key pad.)

*Step 4* *Installing the Key Pad*

Install:
- key pad

(See Section 7.4.5 for more detailed instructions on installing the key pad.)

*Top Enclosure Replacement (Continued)*

### *Step 5 Installing the Main PCA*

Install:
- main PCA
- two Tinnerman fasteners

(See Section 7.4.4 for more detailed instructions on installing the Main PCA.)

### *Step 6 Installing the Top Enclosure*

a. Ensure that the outlet port is still properly seated in the bottom enclosure.

b. While holding the top enclosure slightly above the unit, align the blower cable and power supply PCA cable connectors with their receptacles on the Main PCA. Press the connectors into their receptacles until completely seated.

c. Align the top enclosure with the bottom enclosure then set it in place.

**NOTE:** Ensure that the outlet port is still properly seated in the bottom enclosure.

d. While securely holding the top and bottom enclosure together, carefully turn the unit upside down.

e. Insert and tighten the three Phillips screws to secure the top enclosure to the bottom enclosure.

f. Return the unit to its upright position.

## 7.4.4 Main Printed Circuit Assembly (Main PCA) Replacement

**Solo LX Replacement Part Number 622247**

**Solo Plus LX Replacement Part Number 622248**

| Included in Kits: | Tools Required: |
|---|---|
| Main PCA | Phillips screwdriver (medium) |
| Tinnerman fastener (x2) | Side-cutters |

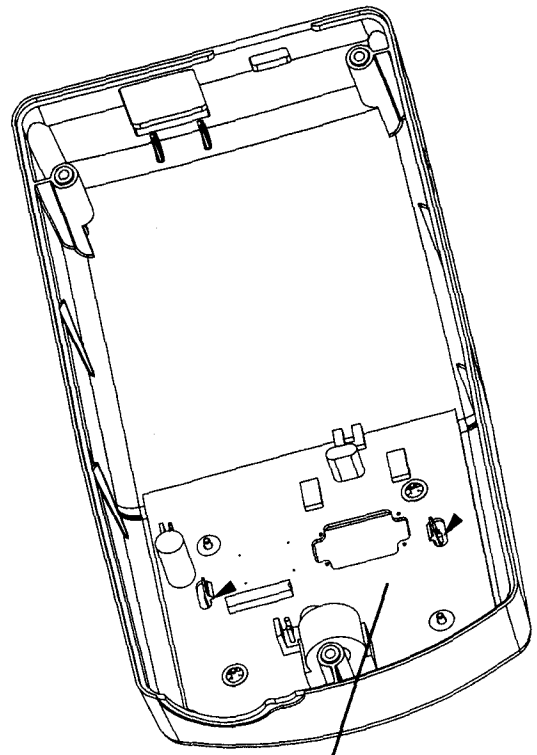
### Procedure

Removed / Installed During Process:

- Top enclosure
- Main PCA

**WARNING:** Electrical shock hazard: Disconnect the electrical supply before attempting to make any repairs to the devices.

**CAUTION:** Electronic components used in these devices are subject to damage from static electricity. Repairs made to these devices must be performed only in an antistatic, ESD-protected environment.



*Main PCA Replacement (Continued)*

*Step 1 Removing the Top Enclosure*

Remove:
- three screws
- blower cable and power supply PCA cable
- top enclosure

(See Section 7.4.3 for more detailed instructions on removing the top enclosure.)

*Step 2 Removing the Main PCA*

a. Place the top enclosure on a protected work surface and carefully turn it over, exposing the underside.

b. Using side-cutters, remove the Tinnerman fasteners.

c. Move the Main PCA locking tabs away from the Main PCA then lift the Main PCA straight up from the top enclosure.

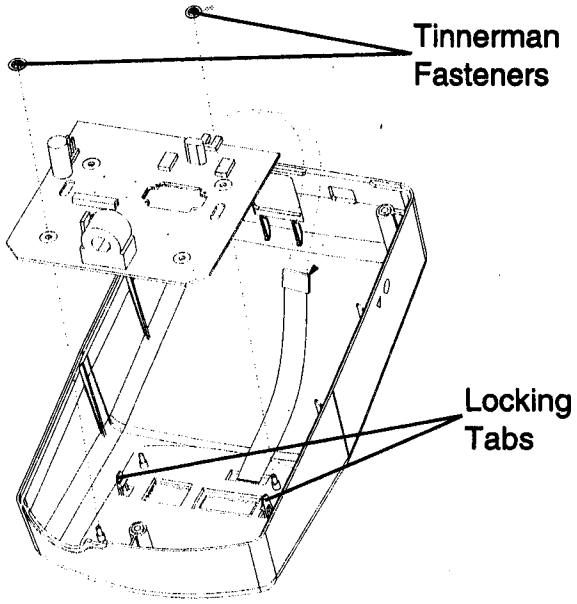



***Figure 7-7***
***Removing the Main PCA***

*Main PCA Replacement (Continued)*

*Step 3 Installing the Main PCA*

a. Align the Main PCA with the four mounting posts and gently press into the top enclosure until the locking tabs "snap" into place. Note that the ribbon cable side of the Main PCA must point towards the back of the top enclosure.

b. Secure the Main PCA with the two new Tinnerman fasteners.

*Step 4 Installing the Top Enclosure*

Install:
- top enclosure
- blower cable and power supply PCA cable
- three screws

(See Section 7.4.3 for more detailed instructions on installing the top enclosure.)

## 7.4.5 Key Pad Replacement

**Solo LX Replacement Part Number 622249**

**Solo Plus LX Replacement Part Number 622250**

| Included in Kits: | Tools Required: |
|---|---|
| Key pad | Phillips screwdriver (medium)<br>Flat-blade screwdriver (small)<br>Isopropyl alcohol<br>Cleaning cloth |

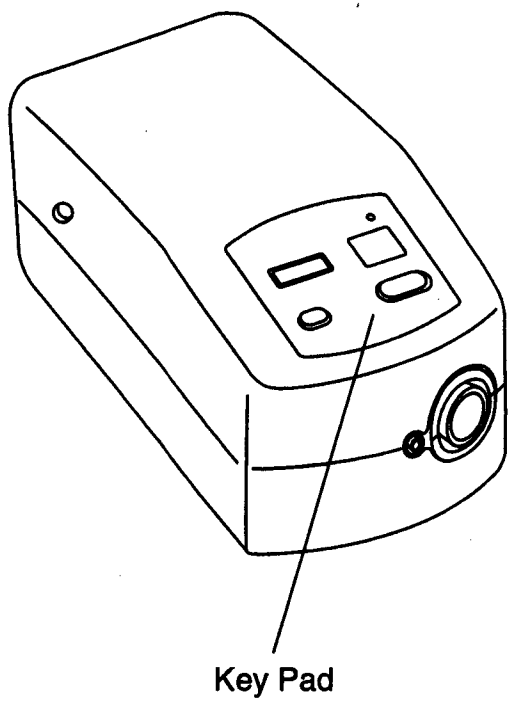
### Procedure

Removed / Installed During Process:

- Top enclosure
- Main PCA
- Key pad

**WARNING:** Electrical shock hazard: Disconnect the electrical supply before attempting to make any repairs to the devices.

**CAUTION:** Electronic components used in these devices are subject to damage from static electricity. Repairs made to these devices must be performed only in an antistatic, ESD-protected environment.



*Key Pad Replacement (Continued)*

### *Step 1 Removing the Top Enclosure*

Remove:
- three screws
- blower cable and power supply PCA cable
- top enclosure

(See Section 7.4.3 for more detailed instructions on removing the top enclosure.)

### *Step 2 Removing the Main PCA*

Remove:
- two Tinnerman fasteners
- main PCA

(See Section 7.4.4 for more detailed instructions on removing the Main PCA.)

### *Step 3 Removing the Key Pad*

a. Working from the inside of the top enclosure, place a flat-blade screwdriver onto the exposed portion of the key pad, next to the ribbon cable. Gently push until the key pad is partially lifted.

b. Working from the outside of the top enclosure, carefully lift upwards on the key pad and remove it from the top enclosure.

**NOTE:** A small amount of isopropyl alcohol may be used during the removal process.

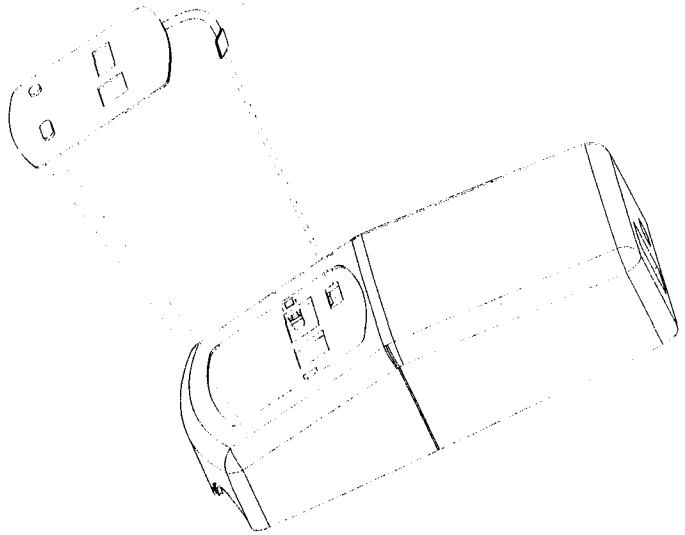


***Figure 7-8***
***Removing the Key Pad***

*Key Pad Replacement (Continued)*

c. As the key pad is being removed, the ribbon cable must be fed through the opening in the top enclosure.

d. Use a small amount of isopropyl alcohol on a cleaning cloth to remove any adhesive residue from the surface of the top enclosure.

*Step 4 Installing the Key Pad*

a. Remove the protective backing from the back of the key pad (make sure the backing under the ribbon cable is removed).

b. Feed the key pad ribbon cable through the opening in the top enclosure.

c. Starting with the front edge, align the key pad with the indentation in the top enclosure then set in place.

d. Using a rubbing motion, press the key pad firmly onto the top enclosure.

*Step 5 Installing the Main PCA*

Install:
- main PCA
- two Tinnerman fasteners

(See Section 7.4.4 for more detailed instructions on installing the Main PCA.)

*Step 6 Installing the Top Enclosure*

Install:
- top enclosure
- blower cable and power supply PCA cable
- three screws

(See Section 7.4.3 for more detailed instructions on installing the top enclosure.)

## 7.4.6 Outlet Port Replacement

### Replacement Part Number 622120

| Included in Kit: | Tools Required: |
|---|---|
| Outlet port<br>Pressure tubing (not used for this repair) | Phillips screwdriver (medium) |

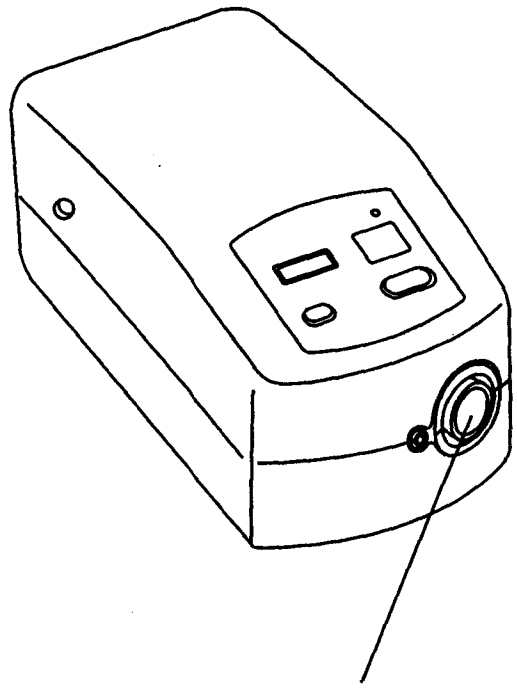
### Procedure

Removed / Installed During Process:

- Top enclosure
- Outlet port

**WARNING:** Electrical shock hazard: Disconnect the electrical supply before attempting to make any repairs to the devices.

**CAUTION:** Electronic components used in these devices are subject to damage from static electricity. Repairs made to these devices must be performed only in an antistatic, ESD-protected environment.



*Outlet Port Replacement (Continued)*

### *Step 1 Removing the Top Enclosure*

Remove:
- three screws
- blower cable and power supply PCA cable
- top enclosure

(See Section 7.4.3 for more detailed instructions on removing the top enclosure.)

### *Step 2 Removing the Outlet Port*

a. Remove the outlet port from the blower outlet by lifting upwards until the outlet port clears the bottom enclosure and pulling it straight out from the blower.

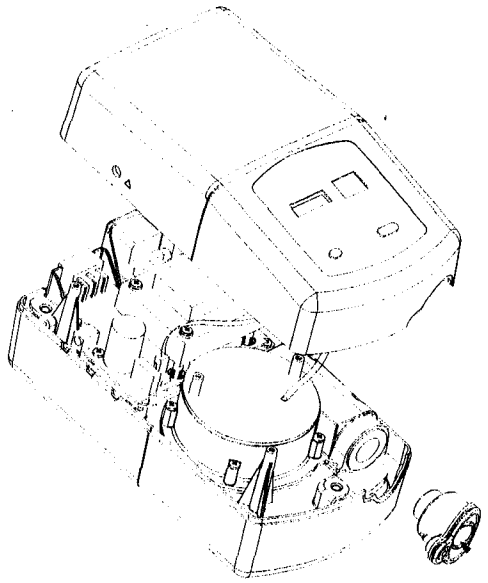


***Figure 7-9***
***Removing the Outlet Port***

*Outlet Port Replacement (Continued)*

*Step 3 Installing the Outlet Port*

a. Grasp the blower assembly and slightly lift the enclosure insert to allow the outlet port to clear the bottom enclosure and be inserted into the blower outlet.

b. Slowly lower the enclosure insert assembly into the bottom enclosure while ensuring that the outlet port is properly seating in the bottom enclosure. Note that the pressure fitting on the outlet port must point towards the middle of the bottom enclosure.

*Step 4 Installing the Top Enclosure*

Install:
- top enclosure
- blower cable and power supply PCA cable
- three screws

(See Section 7.4.3 for more detailed instructions on installing the top enclosure.)

## 7.4.7 Blower Assembly Replacement

### Replacement Part Number 622115

| Included in Kit: | Tools Required: |
|---|---|
| Blower assembly (w / foam baffle) | Phillips screwdriver (medium) |
| Blower-to-enclosure insert seal | Torque wrench (in-lbs.) |
| 6-13 x 1" screw (x6) | |
| Ferrite clamp-on (not used for this repair | |
| Pressure tubing (not used for this repair) | |

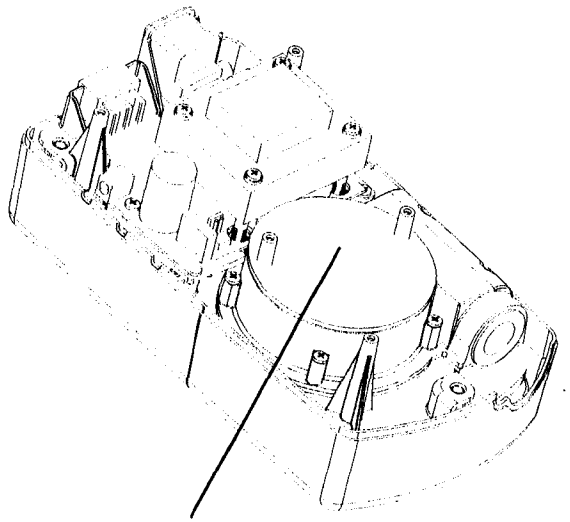
### Procedure

Removed / Installed During Process:

- Top enclosure
- Outlet port
- Blower assembly

**WARNING:** Electrical shock hazard: Disconnect the electrical supply before attempting to make any repairs to the devices.

**CAUTION:** Electronic components used in these devices are subject to damage from static electricity. Repairs made to these devices must be performed only in an antistatic, ESD-protected environment.



Blower Assembly

*Blower Assembly Replacement (Continued)*

*Step 1* *Removing the Top Enclosure*

Remove:
- three screws
- blower cable and power supply PCA cable
- top enclosure

(See Section 7.4.3 for more detailed instructions on removing the top enclosure.)

*Step 2* *Removing the Outlet Port*

Remove:
- outlet port

(See Section 7.4.6 for more detailed instructions on removing the outlet port.)

*Step 3* *Removing the Blower Assembly*

a. Using a Phillips screwdriver, remove the six screws securing the blower assembly to the enclosure insert.

b. While holding the enclosure insert in place, lift and remove the blower assembly.

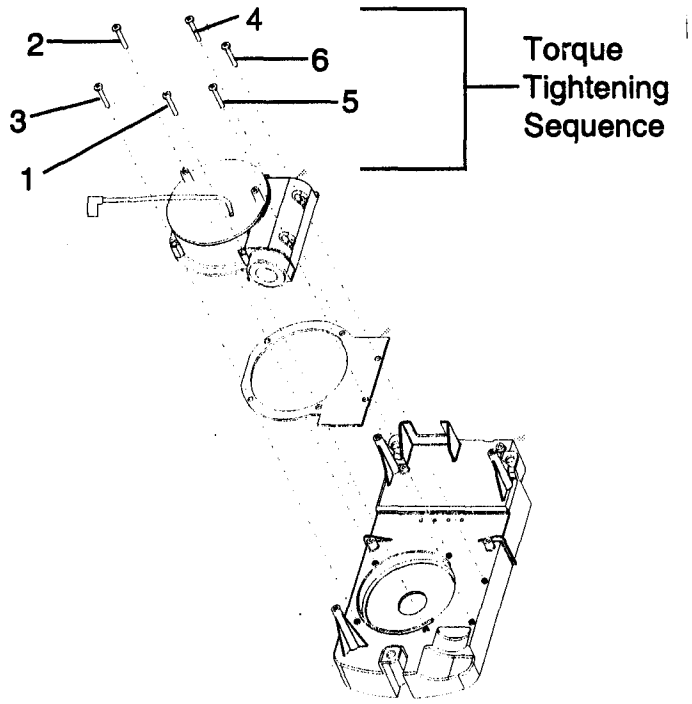



***Figure 7-10***
***Removing the Blower Assembly***

*Blower Assembly Replacement (Continued)*

**NOTE:** Some upward force on one of the edges may be necessary because the blower-to-enclosure insert seal will hold the two pieces together.

c. Remove the blower-to-enclosure insert seal.

*Step 4 Installing the Blower Assembly*

a. Position the blower-to-enclosure insert seal in place on the enclosure insert.

b. Align the blower assembly with the holes in the enclosure insert, then set the blower assembly in place.

c. Insert and tighten the six screws provided to secure the blower assembly to the enclosure insert.

**NOTE:** The screws securing the blower must be torqued to the numbered sequence in Figure 7-10.

**NOTE:** The screws should be torqued to a maximum of 6 in-lbs. Excessive torque may cause the blower impeller to contact the enclosure insert.

*Step 5 Installing the Outlet Port*

Install:
- outlet port

(See Section 7.4.6 for more detailed instructions on installing the outlet port.)

*Step 6 Installing the Top Enclosure*

Install:
- top enclosure
- blower cable and power supply PCA cable
- three screws

(See Section 7.4.3 for more detailed instructions on installing the top enclosure.)

## 7.4.8 Power Supply Printed Circuit Assembly (Power Supply PCA) Replacement

**Replacement Part Number 622265**

| Included in Kit: | Tools Required: |
|---|---|
| Power supply PCA<br>6-13 x 3/8" screw (×2) | Phillips screwdriver (medium) |

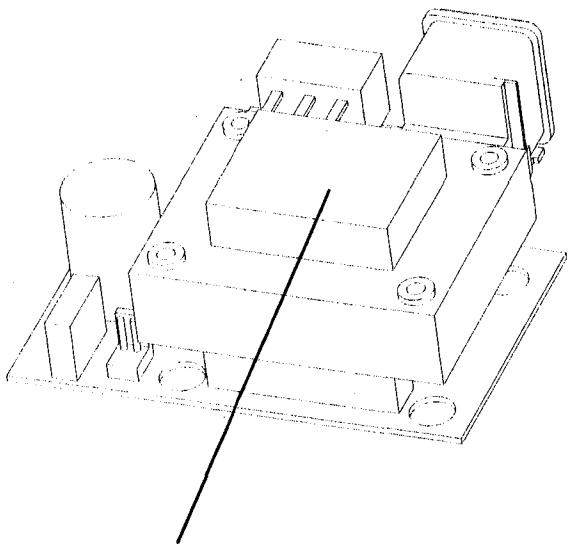
### Procedure

Removed / Installed During Process:

- Top enclosure
- Power supply PCA

**WARNING:** Electrical shock hazard: Disconnect the electrical supply before attempting to make any repairs to the devices.

**CAUTION:** Electronic components used in these devices are subject to damage from static electricity. Repairs made to these devices must be performed only in an antistatic, ESD-protected environment.



*Power Supply PCA Replacement (Continued)*

*Step 1 Removing the Top Enclosure*

Remove:
- three screws
- blower cable and power supply PCA cable
- top enclosure

(See Section 7.4.3 for more detailed instructions on removing the top enclosure.)

*Step 2 Removing the Power Supply PCA*

a. Using a Phillips screwdriver, remove the six screws securing the Power Supply PCA to the mounting plate on the enclosure insert.

**NOTE:** Four of the screws pass through the transformer.

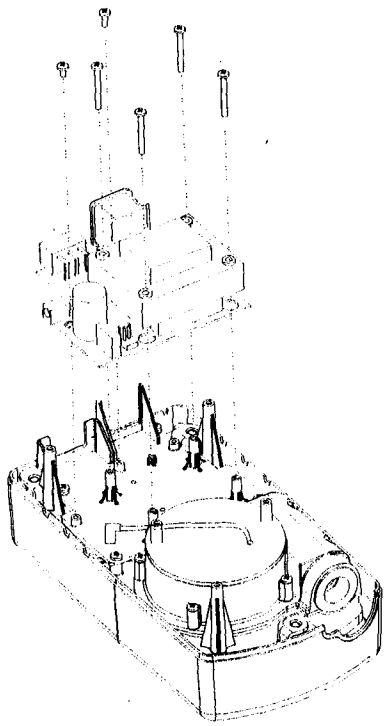


***Figure 7-11***
***Removing the Power Supply PCA***

*Power Supply PCA Replacement (Continued)*

b. While holding the enclosure insert in place, lift the power supply PCA from the mounting plate. It will be necessary to guide the AC input power receptacle from the cut-out in the enclosure insert.

### *Step 4 Installing the Power Supply PCA*

a. Align the holes in the power supply PCA with the holes in the enclosure insert. Note that the AC power input receptacle must be guided into the cut-out in the enclosure insert.

b. Insert and tighten the six screws to secure the power supply PCA to the mounting plate on the enclosure insert.

**NOTE:** Four of the screws pass through the transformer.

### *Step 5 Installing the Top Enclosure*

Install:
- top enclosure
- blower cable and power supply PCA cable
- three screws

(See Section 7.4.3 for more detailed instructions on installing the top enclosure.)

## 7.4.9 Enclosure Insert Replacement

### Replacement Part Number 622119

| Included in Kit: | Tools Required: |
|---|---|
| Enclosure insert (w / foam baffle) | Phillips screwdriver (medium) |
| Blower-to-enclosure insert seal | Torque wrench (in-lbs.) |
| 6-13 x 1" screw (x6) | |

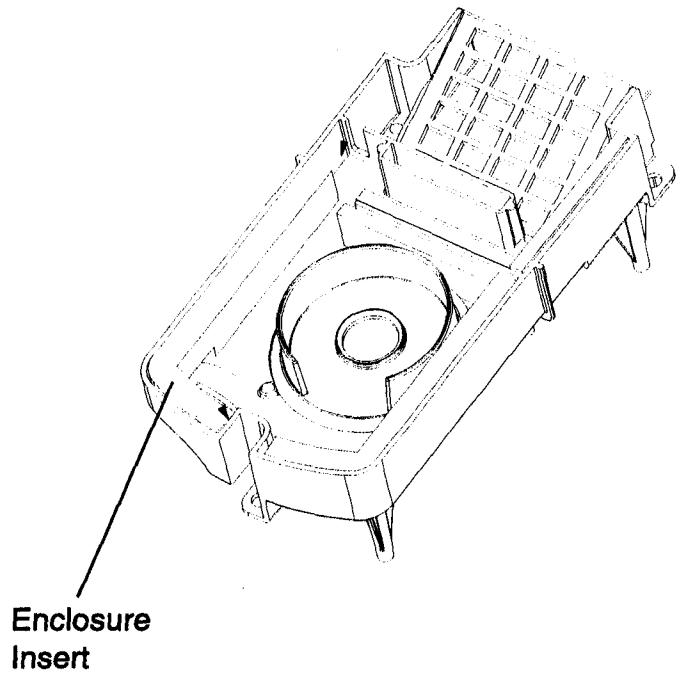
**WARNING:** Electrical shock hazard: Disconnect the electrical supply before attempting to make any repairs to the devices.

**CAUTION:** Electronic components used in these devices are subject to damage from static electricity. Repairs made to these devices must be performed only in an antistatic, ESD-protected environment.

### Procedure

Removed / Installed During Process:

- Top enclosure
- Main PCA
- Outlet port
- Blower assembly
- Power supply PCA
- Enclosure insert



*Enclosure Insert Replacement (Continued)*

*Step 1* *Removing the Top Enclosure*

Remove:
- three screws
- blower cable and power supply PCA cable
- top enclosure

(See Section 7.4.3 for more detailed instructions on removing the top enclosure.)

*Step 2* *Removing the Main PCA*

Remove:
- two Tinnerman fasteners
- Main PCA

(See Section 7.4.4 for more detailed instructions on removing the Main PCA.)

*Step 3* *Removing the Outlet Port*

Remove:
- outlet port

(See Section 7.4.6 for more detailed instructions on removing the outlet port.)

*Step 4* *Removing the Blower Assembly*

Remove:
- six screws
- blower assembly

(See Section 7.4.7 for more detailed instructions on removing the blower assembly.)

*Step 5* *Removing the Power Supply PCA*

Remove:
- six screws
- power supply PCA

(See Section 7.4.8 for more detailed instructions on removing the power supply PCA.)

*Enclosure Insert Replacement (Continued)*

*Step 6 Removing the Enclosure Insert*

a. While holding the bottom enclosure in place, lift the enclosure insert out of the bottom enclosure.

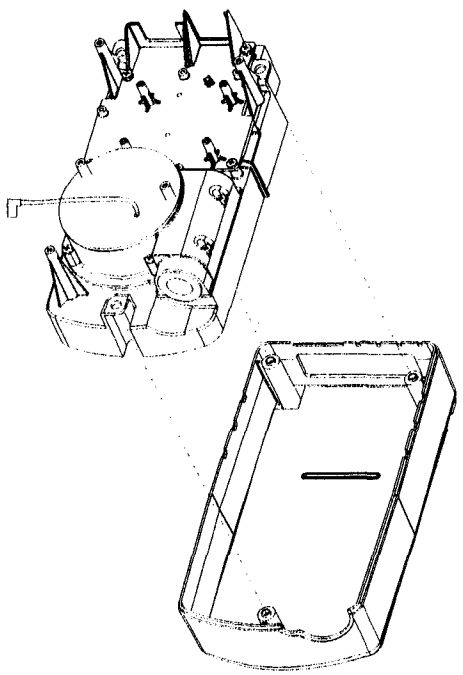


***Figure 7-12***
***Removing the Enclosure Insert***

*Step 7 Installing the Enclosure Insert*

a. Align the enclosure insert then place it into the bottom enclosure.

*Step 8 Installing the Power Supply PCA*

Install:
- power supply PCA
- six screws

(See Section 7.4.8 for more detailed instructions on installing the power supply PCA.)

*Step 9 Installing the Blower Assembly*

Install:
- blower assembly
- six screws

(See Section 7.4.7 for more detailed instructions on installing the blower assembly.)

*Step 10 Installing the Outlet Port*

Install:
- outlet port

(See Section 7.4.6 for more detailed instructions on installing the outlet port.)

*Enclosure Insert Replacement (Continued)*

### *Step 11 Installing the Main PCA*

Install:
- main PCA
- two Tinnerman fasteners

(See Section 7.4.4 for more detailed instructions on installing the Main PCA.)

### *Step 12 Installing the Top Enclosure*

Install:
- top enclosure
- blower cable and power supply PCA cable
- three screws

(See Section 7.4.3 for more detailed instructions on installing the top enclosure.)

# Chapter 8: Testing

8.1 Testing Process ..... 8-3

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8.3 Run-in Test ..... 8-6

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8.5 Solo LX and Solo Plus LX System Final Test Data Sheet ..... 8-8

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# Chapter 8: Testing

## 8.1 Testing Process

The following process should be followed after a repair has been done on the Solo LX and Solo Plus LX CPAP Systems (Solo LX and Solo Plus LX).

Perform the following in order:

1. System Final Test* (Section 8.2)
2. Run-in Test (Section 8.3)
3. System Final Test* (Section 8.2)
4. Post Testing Pressure Setup (Section 8.4)

*The same data sheet is used, but a column is provided to indicate Pre Run-in or Post Run-in Data.

**NOTE:** All testing for international units should be performed at the VAC setting for that specific country.

## 8.2 Solo LX and Solo Plus LX System Final Test

### Purpose

This procedure provides performance testing of the units. The System Final Test will be used prior to and after the Run-in Test. Use the System Final Test Data Sheet in Section 8.5 to record test results.

**CAUTION:** Electronic components used in these devices are subject to damage from static electricity. Use and follow appropriate Electro-Static Discharge (ESD)-procedures.

### Equipment

Digital Manometer (see Appendix A)

Regulated DC Power Supply or 12 V Battery* (see Appendix A)

Watt Meter (see Appendix A)

$O_2$ Enrichment Port (RI P/N 312010)

Whisper Swivel (RI P/N 332113)

Port Cap (supplied with unit) or Stopper

Test Orifice, 60 LPM @ 14.4 cm and 60 LPM @ 3.4 cm (RI P/N 622032)

*Solo LX and Solo Plus LX System Final Test (Continued)*

DC Power Cord* (RI P/N 532210)

Battery Cable Adaptor* (RI P/N 532209)

6 ft. Smooth-Bor Tubing (RI P/N 301016)

* Used for optional DC testing only.

## Equipment Setup

- Place the $O_2$ enrichment port onto the outlet port.
- Place the test orifice (60 LPM @ 3.4 cm – labeled 0.349" diameter orifice (RI P/N 622032)) onto the $O_2$ enrichment port.
- Connect the manometer to the test orifice using pressure tubing.
- Occlude the test orifice.
- Connect the AC power cord to the watt meter but do not connect to the unit at this time.

## Procedure

**Step 1** Minimum Pressure Test (4.0 cm $H_2O$)

a. Enter the Dealer mode by holding down the two User buttons on the key pad and plugging the AC power cord into the unit.

b. Verify the following:

- the blower is running in the unit; and
- the proper altitude setting is indicated on the display.

c. Press the left User button once until the Pressure display appears.

d. Press the right User button until "4" is visible.

e. Occlude the test orifice. Verify the pressure on the manometer is 4.0 cm $H_2O$ (±1.0 cm $H_2O$).

**NOTE:** Allow about 20-30 seconds for the pressure to stabilize.

f. Unocclude the test orifice. Verify the the 60 LPM @ 3.4 cm orifice is within the range of 3.4 – 5.0 cm $H_2O$.

g. Subtract the open flow reading (unoccluded) from the occluded reading. This difference should be less than 1.0 cm $H_2O$.

h. Exit the Dealer mode by unplugging the unit or by holding the Blower On / Off button down and pressing the Ramp button once. Enter the User mode by plugging the AC power cord into the unit.

*Solo LX and Solo Plus LX System Final Test (Continued)*

**Step 2** Maximum Pressure Test (15.0 cm $H_2O$)

a. Connect the following:

- 6 ft. Smooth-Bor tubing to the outlet port on the unit.
- Whisper Swivel II to the 6 ft. Smooth-Bor tubing.
- Test orifice 60 lpm @ 14.4 cm (RI P / N 622032) to the Whisper Swivel II.
- Manometer and pressure tubing to test orifice.
- Occlude test orifice.

b. Ensure the unit blower is off. Unplug the AC power cord from the unit. The green LED will go out.

c. Enter the Dealer mode by holding down the two User buttons on the key pad and plugging the AC power cord into the unit. The same displays used for the Minimum Pressure Test should be visible.

d. Verify the following:

- the blower is running in the unit; and
- the proper altitude setting is indicated on the display.

e. Press the left User button once until the Pressure display appears.

f. Press the right User button until "15" appears.

g. Verify the pressure on the manometer is 15.0 cm $H_2O$ (±2.25 cm $H_2O$).

h. Verify the watt meter reading is less than or equal to 30 watts.

i. Exit the Dealer mode by unplugging the unit or by holding the Blower On / Off button down and pressing the Ramp button once. Enter the User mode by plugging the AC power cord into the unit.

j. Press the Blower On / Off button to restart the blower.

**NOTE:** If a new blower assembly was installed, the wattage may initially be higher. After approximately five minutes of use, the wattage will reduce to within specifications.

k. Press the Ramp button and verify that the pressure drops below 5.0 cm $H_2O$. Pressure will increase in a linear fashion over time until the pressure setting is reached. Verify one increase in pressure change in ramp operation.

l. Turn the blower off.

m. Unplug the AC power cord from the unit.

*Solo LX and Solo Plus LX System Final Test (Continued)*

**Step 3** DC Operation (optional test)

This is an optional test that should be done if a repair was performed that affected the DC operation or if a problem is suspected in this area.

a. Connect the DC inlet plug to the unit.

b. Using the DC Battery Cable, connect to the Regulated DC Power Supply set to 12 VDC (±0.5 V) or to the battery.

c. Turn the unit on. Verify proper functioning by observing a non-zero pressure reading on the manometer. Once observed, turn the unit off.

d. Disconnect the power supply or battery, then remove the DC inlet plug.

# 8.3 Run-in Test

## Purpose

This procedure provides instructions for performing a Run-in Test for the Solo LX and Solo Plus LX. The units will run for one hour at specified parameters to qualify the units after servicing. Use the System Final Test Data Sheet in Section 8.5 to record test results.

## Equipment

Test Orifice, 60 LPM @ 14.4 cm (RI P/N 622032)

## Equipment Setup

- Place test orifice onto the outlet port of the unit.

## Procedure

**Step 1** Enter the Dealer mode by holding down the two User buttons on the key pad and plugging the AC power cord into the unit.

**Step 2** While in the Dealer mode, set the CPAP pressure to 15.0 cm $H_2O$. Exit the Dealer mode by unplugging the unit or by holding the Blower On / Off button down and pressing the Ramp button once.

**Step 3** **Solo Plus LX only** – Record the initial blower hours (xxxxx.x hours) on the data sheet. (See Section 8.5.)

*Run-in Test (Continued)*

**Step 4** Ensure a filter(s) and filter cap are installed in the units.

**Step 5** Ensure that the test orifice (60 LPM @ 14.4 cm – labeled 0.235" diameter orifice (RI P/N 622032)) is unoccluded.

**Step 6** Turn the unit on by pressing the Blower On / Off button.

**Step 7** Run-in for a minimum of 1 hour.

**Step 8** Turn the unit off by pressing the Blower On / Off button.

**Step 9** **Solo Plus LX only** – Record the final blower hours (xxxxx.x hours). Verify that the blower usage increased by one hour or more from the initial reading in Step 3.

# 8.4 Post Testing Pressure Setup (10.0 cm $H_2O$)

## Procedure

**Step 1** Connect the following:

- 6 ft. Smooth-Bor tubing to the outlet port on the unit.
- Whisper Swivel II to the 6 ft. Smooth-Bor tubing.
- Test orifice 60 lpm @ 14.4 cm (RI P / N 622032) to the Whisper Swivel II.
- Manometer and pressure tubing to test orifice.
- Occlude test orifice.

**Step 2** Enter the Dealer mode by holding down the two User buttons on the key pad and plugging the AC power cord into the unit

**Step 3** Press the right User button until "10" is visible.

**Step 4** Verify the pressure on the manometer is 10.0 cm $H_2O$ (±1.5 cm $H_2O$).

**Step 5** Use the System Final Test Data Sheet in Section 8.5 to record test results.

**NOTE:** The System Final Test Data Sheet may be photocopied for a record of unit performance.

# 8.5 Solo LX and Solo Plus LX System Final Test Data Sheet

Serial No. _____ Model No. _____ Date _____ Service Technician _____

**System Final Test (see Section 8.2)**

| Test | Step | Specification | Actual | | Pass | Fail |
|---|---|---|---|---|---|---|
| | | | Pre Run-in | Post Run-in | | |
| Minimum Pressure (Occluded) | 1.e | 4.0 cm $H_2O$ (±1.0 cm $H_2O$) | | | | |
| Pressure (Unoccluded) 60 LPM @ 3.4 cm orifice | 1.f | Between range of 3.4 – 5.0 cm $H_2O$ | | | | |
| Pressure Differential | 1.g | ≤ 1.0 cm $H_2O$ | | | | |
| Maximum Pressure (Occluded) | 2.g | 15.0 cm $H_2O$ (±2.25 cm $H_2O$) | | | | |
| Wattage | 2.h | ≤ 30 watts | | | | |
| Ramp | 2.k | Pressure drops below 5.0 cm $H_2O$ and pressure increases | | | | |
| DC Operation (optional) | 3.c | Non-zero pressure reading | | | | |

**Run-in Test (see Section 8.3)**

| Test | Step | Specification | Actual | Pass | Fail |
|---|---|---|---|---|---|
| Initial Blower Hours (Solo Plus LX only) | 3 | Record Hours (xxxxx.x) | | | |
| Final Blower Hours (Solo Plus LX only) | 9 | At least one hour more than pre run-in blower hours | | | |

**Post Testing Pressure Setup (see Section 8.4)**

| Test | Step | Specification | Actual | Pass | Fail |
|---|---|---|---|---|---|
| Post Testing Pressure Setup | 4 | 10 cm $H_2O$ (±1.5 cm $H_2O$) | | | |

# Appendix A: Tools and Equipment

A.1 Service Tools and Supplies ..... A-3

A.2 Acceptable Test Equipment ..... A-4

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# Appendix A: Tools and Equipment

## A.1 Service Tools and Supplies

You should have the following hand tools and supplies available for troubleshooting, testing, and repairing the Solo LX and Solo Plus LX CPAP Systems (Solo LX and Solo Plus LX).

- Common Hand Tools

  Flat-blade screwdriver - small

  Phillips screwdriver - medium

  Side-cutters

- Antistatic, Electro-Static Discharge (ESD)-protected work station – minimum requirement is a grounded mat and wrist strap
- Battery, 12 Volt* – see Section A.2
- Battery Cable Adapter* (RI P/N 532209)
- Cleaning cloth
- DC Power Cord, optional (RI P/N 532210)
- Digital Manometer – see Section A.2
- End Cap (supplied with unit)
- Isopropyl alcohol
- Mild detergent
- $O_2$ Enrichment Port (RI P/N 622032)
- Regulated DC Power Supply* – see Section A.2
- 6 ft. Smooth-Bor Tubing (RI P/N 301016)
- Test Orifice (RI P/N 532232)
- Torque wrench (in-lbs.)
- Watt Meter – see Section A.2

* Used for optional DC testing only.

# A.2 Acceptable Test Equipment

## A.2.1 Digital Manometer*

Specifications:

0 – 25 cm $H_2O$ (or better)

±0.3 cm $H_2O$ accuracy

±0.1 cm $H_2O$ resolution

Acceptable Options:

- Respironics Digital Manometer (RI P/N 302227)
- Merical DP2001
- Sensym PDM 200CD
- RT-200
- Any commercially available digital manometer that meets the above specifications.

* A water column manometer may also be used.

## A.2.2 Watt Meter

Specifications:

0 – 100 W

3% accuracy

1 W resolution

Acceptable Options:

- Yokogawa 2355 (digital)
- Simpson, Analog 0 – 150 W
- Extech DW 6060
- Any commercially available watt meter that meets the above specifications.

*Acceptable Test Equipment (Continued)*

## A.2.3 Digital Multimeter

Specifications:

2.5 digit readout minimum

0.0 – 20.0 VDC

0.0 – 25.0 VAC

Acceptable Options:

- Fluke 83 or better model
- Any commercially available digital multimeter that meets the above specifications.

## A.2.4 Regulated DC Power Supply (optional)

Specifications:

12 volts DC (±0.5 V) output

Regulates to 5 amps.

Acceptable Options:

- Any commercially available power supply that meets the above specifications.

## A.2.5 Battery (optional, for testing only)

Specifications:

12 volts DC

Acceptable Options:

- Any commercially available battery that meets the unit's input voltage and current requirements.

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# Appendix B: Schematics

B.1 Schematic Statement ..... B-3

B.2 Solo LX Main Printed Circuit Assembly (PCA) ..... B-4

B.3 Solo Plus LX Main Printed Circuit Assembly (PCA) ..... B-6

B.4 Power Supply Printed Circuit Assembly (PCA) ..... B-8

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# Appendix B: Schematics

## B.1 Schematic Statement

Schematics are supplied with this manual in direct support of the sale and purchase of this product.

**The schematics are proprietary and confidential. Do not copy the schematics or disclose them to third parties beyond the purpose for which they are intended. Patents are pending.**

The schematics are intended to satisfy administrative requirements only. They are not intended to be used for component level testing and repair. Any changes of components could affect the reliability of the device, prohibit lot tracking of electronic components, and void warranties. Repairs and testing are supported only at the complete board level.

The schematics are of the revision level in effect at the time that this manual was last revised. New revisions may or may not be distributed in the future.